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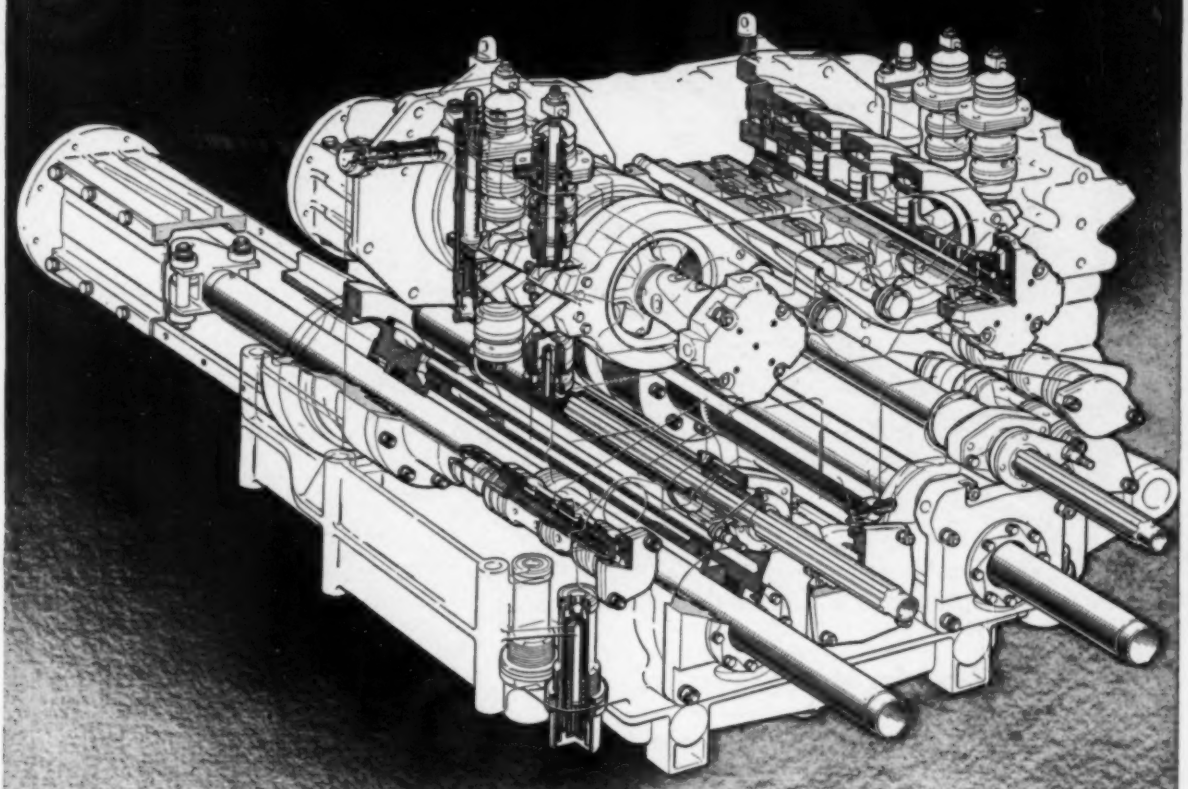

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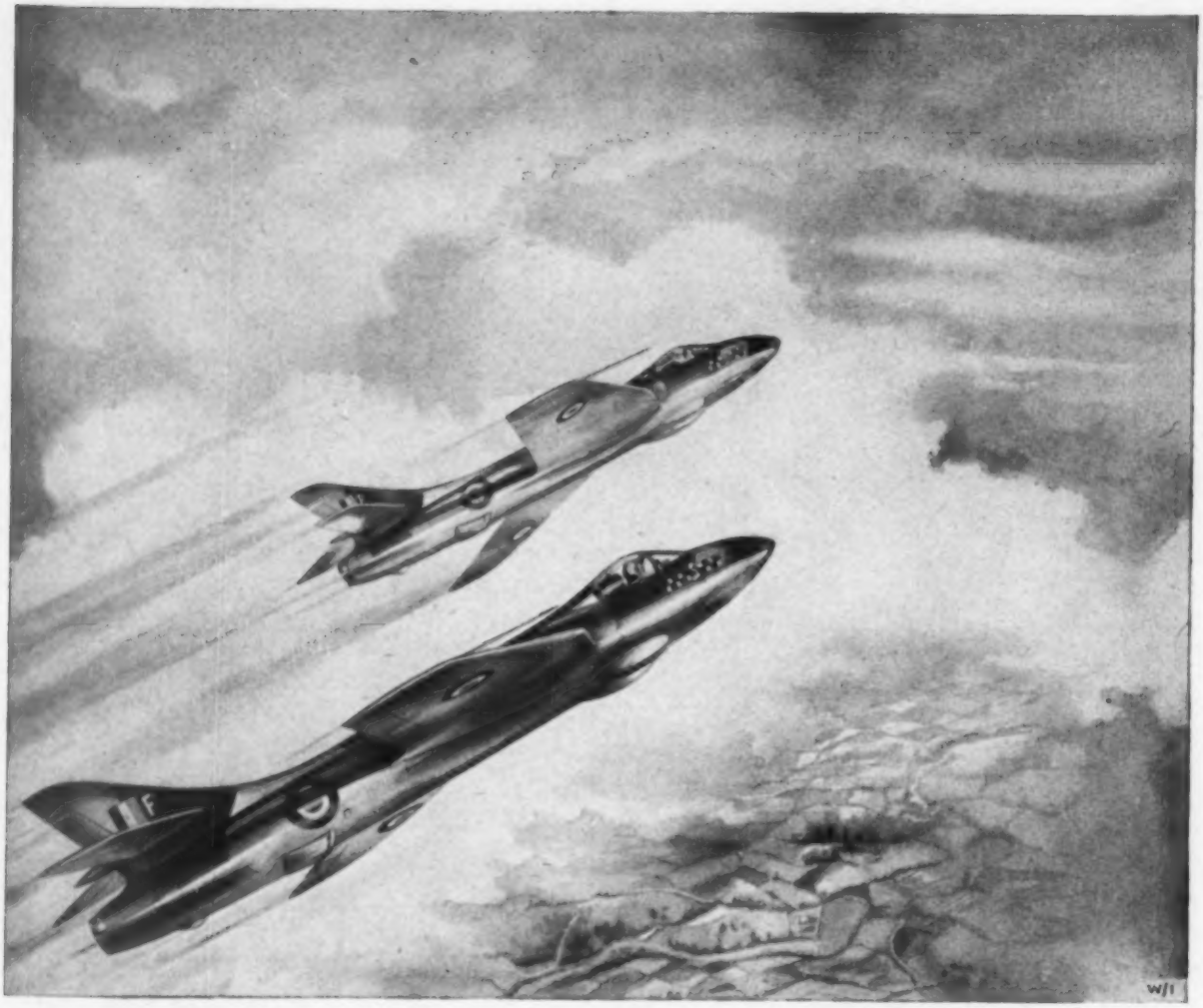

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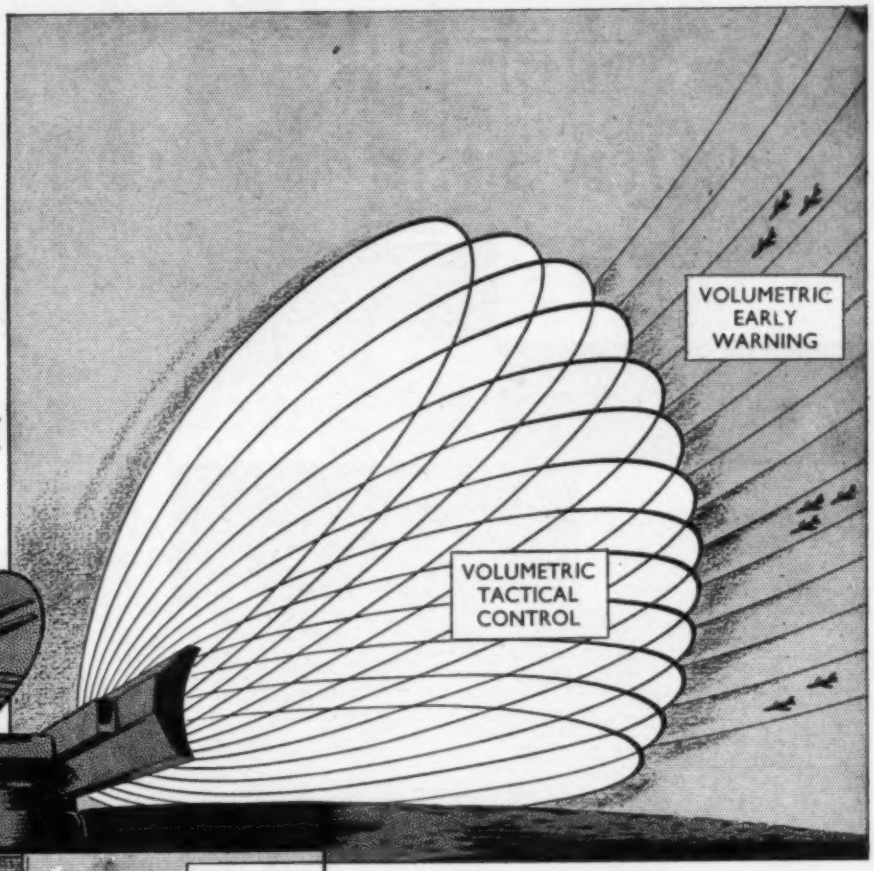

The Battle Picture...

For 22 years Metropolitan-Vickers have developed, manufactured and installed in many parts of the World the static and mobile radar stations that have given warning of air attack and displayed the battle picture.

THE efficiency of a defence system, whether based on guided weapons or supersonic interception aircraft or both, still depends on having adequate warning of attack with accurate information on height, bearing, range and identity. Supersonic speeds, however, demand much longer ranges for detection with automatic computation of the continually changing tactical data and its injection into the defensive system.

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this Filter talk will drive me round the bend!

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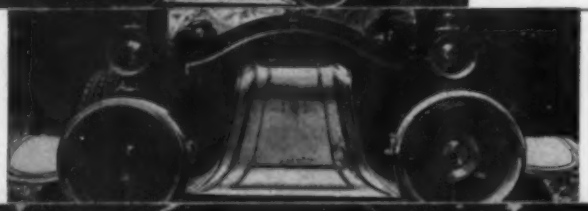
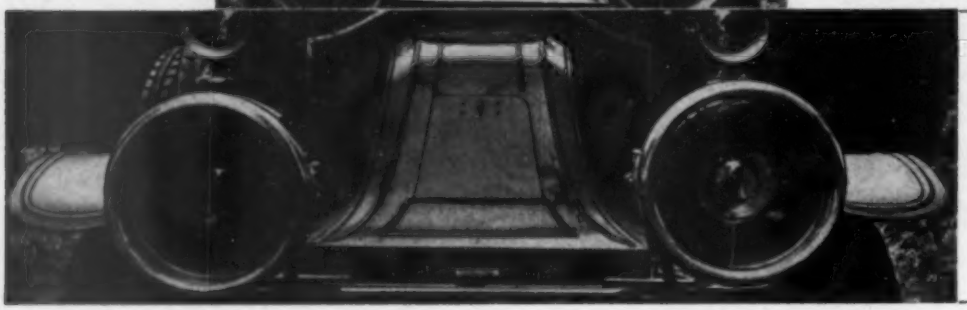
That's the trouble with your infantile modern engines—they have to be fed on strained foods or they get indigestion. Now look at Dotty . . .



Exactly. Do you really think she enjoys having that steam pouring through her exhaust? Now if you took a Simmonds Fram Separator Filter in tow you could have 100% water separation and complete filtration of solids down to 5 microns.



It's tempting, very tempting . . . but it wouldn't be fair on the other competitors. Now d'you mind if we stop a minute . . . I think I really will have to get the rest of that bird's nest out of the tank.

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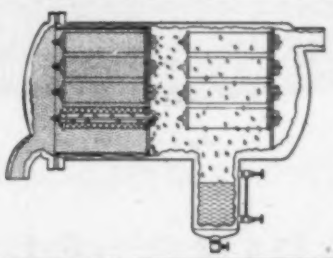

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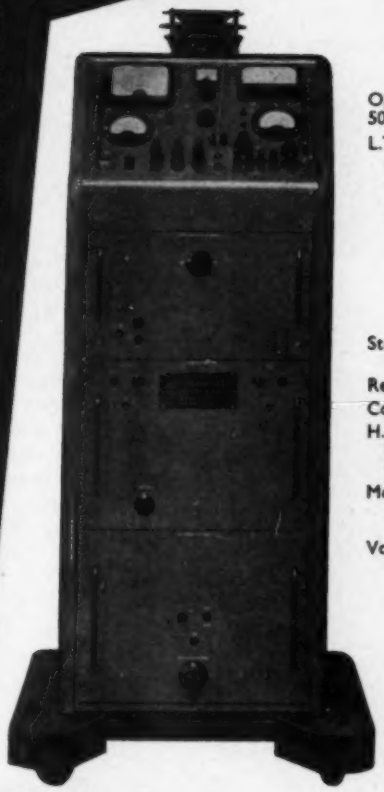

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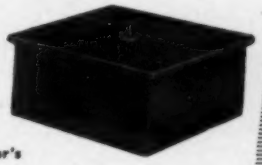

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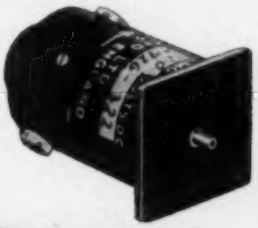

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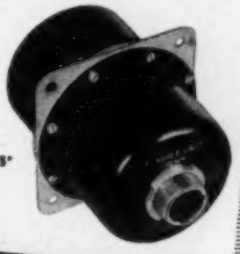

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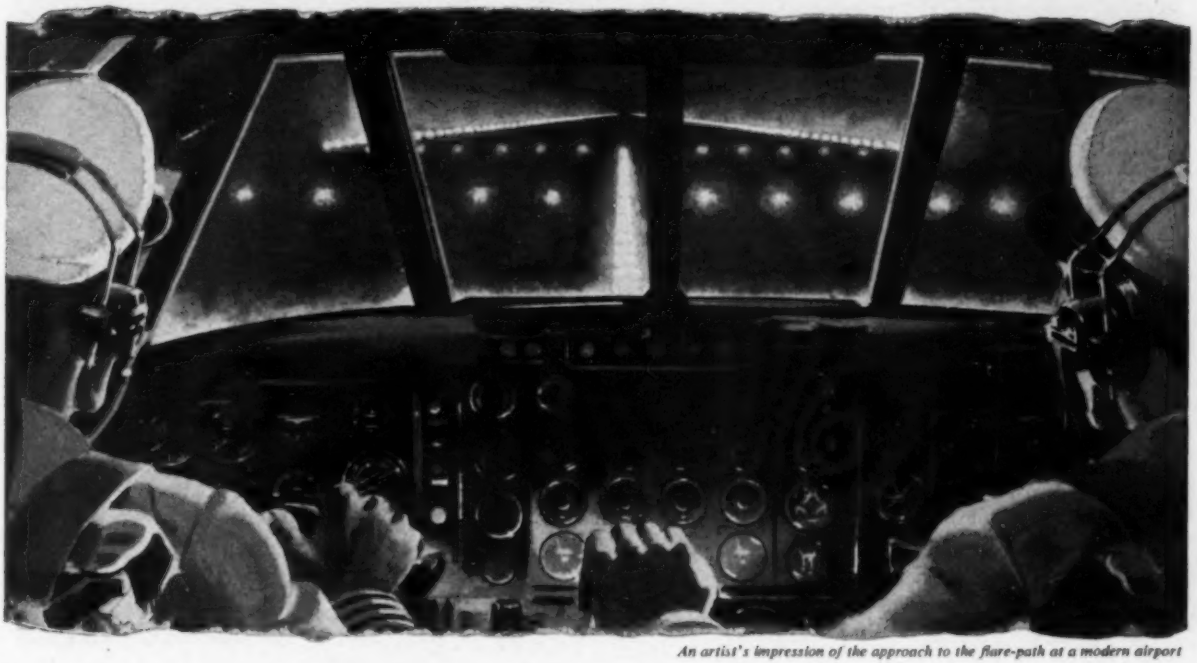
Electrification of the Modern Airport



An artist's impression of the approach to the flare-path at a modern airport

Out of the night sky, the airliner descends in a long and gentle glide. From many miles distant, the location beacon has been picked up. Now, over to port, the identification beacon flashes the airport signal and, ahead, approach lights point the way to the runway lighting. Safely down, the flight is over.

Airport lighting has become a complex science—a far cry from those first night flights made in the beam of car headlamps. And the G.E.C., with its wealth of experience and highly specialised staff, has long been associated with the development of the lighting demarcation system now almost universally standardised. Approach, runway and taxiway lighting layouts, loading and maintenance floodlights, hangar, roadway and car park lighting and ground traffic control systems reflect the vital contribution made by the G.E.C. in this important field.

Lighting, however, is but one facet of the electrification of the modern airport. G.E.C. installations embrace telecommunication systems for aircraft and passenger control, electric cooking equipment for the airport flight kitchens and electrically heated food containers enabling hot food to be served in flight—also equipment for aircraft maintenance and for the maintenance and administration of the airport itself. In addition, the Company supplies the sub-stations, switchgear and circuits that are required for power distribution and lighting control.

Equipment that complies with the standards of the International Civil Aviation Organisation has been installed by the G.E.C. on airports in every part of the world.

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B

"Equal to, if not better than, any Bomber in the World"

—Mr. C. I. Orr-Ewing, Under Secretary for Air.

In announcing that the famous 617 Squadron—the Dam Busters—is to be reformed and equipped with the Avro Vulcan Delta Bomber, believed to be the fastest bomber in service anywhere, Mr. Charles Ian Orr-Ewing, Under Secretary for Air, has said that in the Vulcan "we now have a bomber aircraft which is equal to, if not better than, anything else in the world".

"The Vulcan comes from a good stable"

In addition to Mr. Orr-Ewing's tribute, the Air Officer Commanding No. 1 Group, Bomber Command, had this to say: "We are extremely pleased with the Vulcan, both from the operating and the maintenance aspects. The way in which this large aircraft and its complex system has been brought into use in the front line of Bomber Command, without any of the enforced groundings so frequently experienced with new types of aircraft, is most gratifying. The Vulcan is giving us splendid utilization; indeed, it is far better than we experienced with any other type of aircraft, large or small. The Vulcan comes from a good stable and is liked by the servicing crews as well as the flying crews."

We are proud of our stable—from it have come: *the Avro '504'—the first long-range bomber of World War 1; the faithful Anson; the immortal Lancaster, used by the Dam Busters in World War 2; and now the Vulcan.*

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FIRST AERONAUTICAL WEEKLY IN THE WORLD FOUNDED 1909

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and
AIRCRAFT ENGINEER

No 2571 Vol 73 FRIDAY 2 MAY 1958

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Research for Tomorrow

IT will be five years this August since the Rolls-Royce Flying Bedstead first went screeching into the air. Here, surely, was the most grotesque object ever sustained above the earth; and for a year it remained (Heaven knows how) a secret—until the S.B.A.C. Dinner on the eve of the 1954 Farnborough Display.

Following S.B.A.C. tradition, the guest of honour was the Minister of Supply then in office—Mr. Duncan Sandys; and with admirable dramatic sense he saved his portentous news for the end of his speech. Having alluded to America's VTO tail-sitters (exotic birds whose season may not yet have ended) he attained the climactic moment. "We in Britain," he proclaimed, "are concentrating rather upon techniques designed to enable aircraft to take off vertically from a normal horizontal position. . . In conjunction with the Ministry of Supply, Rolls-Royce have constructed a test vehicle embodying this principle, and a few weeks ago [he had in mind the first free hovering] this strange contraption lifted itself into the air. . . It proceeded to circle around under complete control . . ." Mr. Sandys concluded, "It may well be that this new and exciting experiment will lead to a revolution in aeronautical development every bit as important as that which has resulted from the introduction of the jet engine."

Continuing trials have led Rolls-Royce and the Government to reaffirm their faith in the latent possibilities of jet lift. The RB.108 turbojet has been developed as a special "lift engine" and has been installed in the Short SC.1 VTOL research aircraft. As we write, preparations are in hand for preliminary hovering trials. But whereas Rolls-Royce have hitherto been advocating the system principally in its application to a highly supersonic transport aeroplane (the Griffith "dart" project, subject of a detailed review in this and last week's issue of *Flight*), Mr. David Keith-Lucas, designer of the SC.1, has himself emphasized that VTOL as an accomplished fact is with us *now*. It would be tragic, he declares, if we in Great Britain came to associate it solely with the far-off dream of a supersonic airliner—wherein VTOL is simply a means to an end. The danger he foresees is that we might couple the system with the enormous development costs of the distant supersonic project and thereby fail to apply it to present needs.

— and the Day After

This warning can be related to an example, cited by Sir Arnold Hall, of the evils of abandoning research too early because the outcome may be obscure—indeed, may be proved by experts to be impossible. The example (instanced by Mr. E. C. Bowyer, director of the S.B.A.C., in his recent admirable address to the Institute of Petroleum) was this: Basic research on transonic and supersonic flight was started early in the 1940s and was continued in spite of high-level expert opinion that transonic and supersonic speeds must remain out of reach because piston engines could not possibly be developed to give enough power for weight. Few at that time foresaw the gas turbine aero-engine.

A second example is that in the early days of research on long-range missiles some "experts" knew full well that these were likely to be most inaccurate, and therefore completely unsatisfactory. Few had thought of the nuclear warhead.

As Mr. Bowyer has remarked, research cannot be turned on and off like a tap. We in this country have no choice other than to stay in the van of advanced engineering. We have to import fuels and raw materials; and we can only pay for these things if we export products which other people cannot make or make so well. This means research, research and again research.

Hiatus can spell disaster; but we do not believe that the Minister of Supply is blind to this, for he has set up a committee to study the state of the industry following transition from mainly military to mainly civil work, and he hopes to report its findings "in the spring."

Thus, we have until June 21 to await the helpful and encouraging Government statement of which a worried industry is so earnestly in need.

COMET HISTORY was made at 6.13 p.m. last Sunday, April 27, when the first production de Havilland Comet 4, G-APDA made its maiden flight at Hatfield. The aircraft was airborne for 83 minutes with John Cunningham in command. The Comet 4 story was told in "Flight" for March 28; a further note appears on page 618, and another photograph on page 619.

FROM ALL QUARTERS

Duke of Edinburgh at Vickers

DURING the course of a six-and-a-half-hour visit to Vickers-Armstrongs (Aircraft), Ltd., last Friday, the Duke of Edinburgh was able to see the overall picture of current production at Hurn, Wisley and Weybridge. His tour began with a flight from London Airport to Hurn in a Viscount V.745 piloted by G. R. Bryce and E. B. Trubshaw (chief test pilot and deputy). Also on board were Lord Knollys, Maj-Gen. C. A. L. Dunphie, Sir George Edwards, and other directors and senior executives.

The royal visitor spent 45 minutes at Hurn inspecting the Viscount production lines, then left in the same aircraft for Wisley, where there was a line-up of Vickers' types, both modern and historic—Valiant, Scimitar, Swift, Spitfire and S.6B. He was also shown the company's anti-tank missile and the Alcock and Brown museum. On the Hurn - Wisley trip Prince Philip himself flew—and landed—the aircraft.

After luncheon at the nearby main works at Weybridge the Duke spent two-and-a-half hours in going round various departments: the design office, Viscount 800 production lines, the stratosphere chamber and the Vanguard assembly lines. He also inspected the Vanguard mock-up and afterwards had tea in the apprentice school. *Picture: page 594.*

Bristol Siddeley Engines, Ltd.

LAST Monday, April 28, the Bristol Aeroplane Company and the Hawker Siddeley Group announced the formation of a joint company, with the above title, to "co-ordinate the activities" of their respective engine companies.

This move no doubt has its inspiration in the joint company formed last Christmas to develop the Bristol 200 jet airliner for B.E.A. The two engine firms have no conflicting interests; their products are in fact fully complementary, covering virtually every class of aircraft propulsion. The new company, which has Sir Arnold Hall of Hawker Siddeley as chairman and A. Cdre. F. R. Banks of Bristol Aero-Engines as vice-chairman, will be owned half-and-half by the two engine concerns.

No merger has taken place; for the present, at least, the new company signifies a closer technical liaison between the two firms so as to make better use of their resources. In practice this will mean, to quote Sir Arnold, "a complete exchange of technical information, combined production planning . . . and a common technical policy."

This is the third industrial regrouping to follow the Government's "closer association" policy—the others being Airco (D.H.-Hunting-Fairey) and the Bristol 200 company referred to above. No financial mergers have taken place: "these things do not happen overnight," Sir Arnold Hall commented last week.

The directors of Bristol Siddeley, other than Sir Arnold Hall and A. Cdre. Banks, are: Sir Alec Coryton (Bristol); Dr. S. G. Hooker (Bristol); Mr. G. L. Hack (Bristol); Mr. H. T. Chapman (Armstrong Siddeley); Mr. W. F. Saxton (Armstrong Siddeley); Mr. W. H. Lindsey (Armstrong Siddeley).

Skylark I.G.Y. Firing

AT Woomera on April 17 the sixth Skylark altitude research rocket was fired to a height of 90 miles. This was the first firing in the high-altitude research programme arranged jointly between the Royal Society and the Ministry of Supply as part of Britain's contribution to the I.G.Y. and the following official description has been given of the firing:—

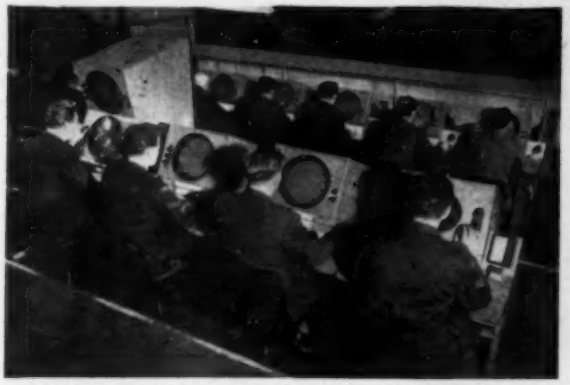
"The rocket carried eighteen grenades, fourteen cartridges of metal foil and the insulated cone ionospheric experiment provided by university groups, together with Pirani pressure gauges, accelerometers, and a standard installation of telemetry, Doppler transponder and microwave beacon provided by R.A.E. Farnborough.

"The grenades were timed to explode at intervals between 100,000ft and 330,000ft, as part of an experiment by the Physics Department of University College, London, designed to measure temperatures and winds. The metal foil was timed for release as two separate clouds at 140,000ft and 234,000ft, which were then tracked by radar, to give the Department of Meteorology, Imperial College, information on high-level winds. The University of Birmingham (Department of Electron Physics) ionospheric experiment measured electron densities as the rocket entered the ionosphere at about 300,000ft. The Pirani gauges measured ram and cone wall pressures."

The British IRBM

THAT the United Kingdom is engaged in the independent development of an intermediate-range ballistic missile was announced by the Minister of Defence in August last year. It can now be revealed that the system manager for this vast undertaking is de Havilland Propellers, Ltd. As prime contractor, this company co-ordinates the work of others engaged in the project, the main sub-contractors being de Havilland Aircraft, Rolls-Royce and Sperry (obviously responsible for airframe, propulsion and guidance, in that order). It is announced that the weapon will carry "a thermonuclear warhead" a distance of "several thousand miles"; range and payload are naturally interdependent and the combination of these two factors suggests a weapon with rather higher performance than the first generation of American land-based

ZUMMERZET TO BLUE DANUBE: The six Westland Whirlwinds ordered by the Austrian Government—four of which were being formally handed over last Tuesday (see news-item, p. 605)—seen at Yeovil, where four pilots, headed by Col. Gustav Hauck, Austrian Air Force chief helicopter pilot (seen at left), have been undergoing familiarization.



***ANGELS FIVE FIVE:** The operators in this experimental tactical control centre at the R.R.E. (see news item below) feed target information into a data store computer so that it can be reproduced on synthetic displays used directly by missile or fighter controllers.*

***FARM FELINE:** Production of the Grumman Ag-Cat agricultural biplane (prototype pictured above) is now under way at the company's Bethpage plant. Upper and lower wings are interchangeable; any of several 200-300 h.p. engines may be fitted, and hopper load is 1,000 lb.*

IRBMs, which have a design range of less than 2,000 miles.

For well over a year the propulsion system cold-flow rig has been operative at Hatfield, and static firings will be conducted at the Spadeadam facility managed by Rolls-Royce. Last week the cylindrical portion of the airframe, approximately 60ft high and 10ft in diameter, was erected in a vertical position on the Aircraft Company's part of Hatfield aerodrome.

P.1B Order

A FURTHER order for English Electric P.1Bs for the R.A.F. was announced in the House of Commons by the Minister of Supply, Mr. Aubrey Jones, last Monday. The size of the order was not disclosed, but it is believed to be a substantial one, probably for 100 aircraft. Up to now five prototype machines (three P.1As and two P.1Bs), 20 pre-production aircraft and an unspecified number—about 50—production P.1s have been ordered. The order announced by the Minister was for both the fighter and the trainer version.

NA.39 Setback

AFTER having been transported by road from the makers' plant at Brough, East Yorkshire (picture, *Flight*, April 18), the prototype Blackburn NA.39 strike aircraft for the Royal Navy began taxying trials at R.A.E. Bedford, on April 22. Unluckily a tyre burst, and the aircraft ran off the runway. Trials were about to be resumed when we closed for press earlier this week. Derek Whitehead is the pilot.

Willoughby Lappin Retires

WITH the retirement of Willoughby Lappin, C.B.E., at the end of April from Rolls-Royce, Ltd., both the company and industry and senior R.A.F. officers lose a friend and counsellor of long experience and high influence.

Mr. Lappin.

Mr. Lappin's position for much of his 40 years with Rolls-Royce was that of personal assistant to Lord Hives, and after the latter's retirement to Mr. J. D. Pearson, the chief executive and deputy chairman; but the boundaries of his work were not limited by a strict interpretation of his duties as a p.a.: it was once said that Willoughby Lappin "worked for the R.A.F. and was paid by Rolls-Royce." What this amounted to in practice was seeing that the company's engines met all requirements and were operated to the best advantage. He flew with test and Service pilots and attended weekend training with Auxiliary squadrons; thus he knew at first hand what the R.A.F. required, gained the friendship and confidence of many officers who now hold the highest rank, and acquired what has been described as an "ambassadorial influence" within the world of military aircraft.

Mr. Lappin served in the R.N.A.S. from 1914 to 1917 and when he joined Rolls-Royce in the latter year was told to "make himself useful in the London office." His interpretation of this instruction, during the great period of the company's history covering the Eagle VIII, Kestrel, Merlin and now the Conway, has earned him the description of "the salesman who sold thousands of engines but never booked an order."

R.R.E. Shows its Work

LAST week, for the first time since 1948, the Royal Radar Establishment at Malvern opened its gates to a party of invited guests. A large cross-section of the work of the Establishment was put on view, including work on computers, solid-state physics, infra-red missile homing systems, Doppler radar and radar defence systems.

New among the standard range of Doppler radars was one associated with Decca Radar. Its tracker is fully transistorized, it has a very small, flat, pitch-stabilized aerial, and power-drain is 200 w. Total weight is to be in the region of 100 lb, although the drift and groundspeed element alone could be reduced to as little as between 60 and 70 lb. The Marconi AD.2000 Doppler, also on view, which has been in R.A.F. squadron service for four years, has shown 95 per cent reliability, while its smaller brother, the AD.2100, offers an accuracy better than 0.3 deg of drift and 0.3 per cent of distance flown. It is suitable for mounting in external pods.

One of the physics department exhibits showed the growing of large crystals for Masers (microwave amplification by stimulated emission of radiation). One of the main uses of these crystals is in reducing noise in crystal mixers and I.F. amplifiers in microwave receivers, allowing detection of a signal against a strong noise background.

The missile department displayed an air-to-air research missile with infra-red homing head, in which two convex mirrors collected and concentrated radiation from a target on to a photo-conductive cell. The nose was made up of glass segments like those of Firestreak. A film was shown depicting a tracking camera being aimed accurately by the detector at the starboard efflux of a Canberra which was "jinking" sharply with its undercarriage down.

In many ways the most impressive item was an experimental defence system. It is based on three radars, one for early warning, one for tactical control and the third for surface-to-air missile guidance. In the central control room the "tote board" was electronic and a controller with both e.w. and tactical p.p.i. displays allotted targets to one of two groups of trackers. One of these, with a joystick, steered a ring marker in the p.p.i. on to the blip. He then pressed a switch which fed the target position into a central data store computer; and a bright spot of light appeared next the blip to indicate acquisition. Two other trackers then steered rings on their own p.p.i.s over each of the target blips thus marked and fed information on target vector into the store. A fourth operator assessed the exact height of each target and fed that information, too, into store.

The tactical radar for this operation uses a flat transmitter aerial rotating at 10 r.p.m., return echoes being filtered through an electronic lens and reflected into a stack of eleven receiver horns. Thus an approximate height is automatically obtained for each echo. A version of this radar is made by Metropolitan Vickers. The weight of the aerial system is about 13 tons.

Weapon controllers sit at further consoles and can select two forms of synthetic display produced by the data store in addition to the straight tactical scan. One shows letters instead of blips, denoting hostile, friendly or unidentified targets, with rings indicating the positions of defence sites. The other shows a code number over the position of each blip. Flashing signals tell the controller when a weapon is ready to take on a target and he simply presses a numbered switch and feeds computed target information to the ground precision radar (made by B.T.H.) mounted on a trailer in the field. A broad beam from this radar locates the target and then locks on with a pattern of four overlapping beams which provide aiming error signals to 40 h.p. motors in the mounting. The four-ton dish aerial, stressed against high winds, is locked on and the missile fired by a controller. Radar tracking is accurate to within a few seconds of arc and a few feet of range at distances probably over 30 miles. The quality of the radars, the computer data store and the synthetic p.p.i. displays are particularly noteworthy. Manual plotting and telling in the tactical centre are eliminated.

The control room, as shown at Malvern, must have represented the nucleus of a completely new, largely automatic defence system employing both intercepters and missiles. The actual geographical relationship of tactical and early-warning radars was not stated.

The Pentagon, in which is housed "the team of 30,000 people who administer and plan for the 250 U.S. bases throughout the world."

Defense

A CONDUCTED TOUR OF U.S. AIR POWER

PART ONE — PARIS TO THE PENTAGON

By a Special Correspondent

THE U.S. Armed Services have accorded special facilities to enable a selected party of journalists to inspect their newest equipment and methods. This is the first of a series of articles describing the tour, with emphasis on the aircraft and missile aspects.

FLYING MATS is not such a magical thing as it sounds. If ever the United States goes out of the armament business it will have a ready-made airline which could knock a considerable number of spots off some I.A.T.A. members we could mention. Even in the matter of stewardesses.

We reported at the Military Air Transport Service terminal at Orly, Paris, on the evening of April 18. The United States Air Force, working with the U.S. Department of State, planned to show us something of Americana as well as Air Force activities which we Western journalists usually learn only from hand-outs, impassioned news stories from Washington and—of course—the cinema.

We checked-in ready for our four weeks' tour with clothing to suit weather in Lincoln (Nebraska), El Paso (Texas) and some of the hotter spots in Los Angeles. The coloured master-sergeant behind the counter referred to us as gennlemen, apologized for having to charge us 75 cents for our "lunch" (to be consumed about 10 p.m., but not more than five hours after issue, because they'd had one or two cases of food poisoning when passengers had left it longer before they ate), and checked our passports.

Our aircraft would be landing in ten minutes from Frankfurt, he told us. Flight number was A 420, the "chicken" (because you can stuff so many passengers into it) was a C-118, or military DC-6A, and we should be routed via the Ay-zores.

Remembering dear old Transport Command and some of its equipment, we weren't looking forward to this long haul in a military transport. It was only when we realized that the two glamorous young women we had seen lurking in the lounge were not flight stewardesses with PanAm but were actually airwomen of the U.S.A.F. that we perked up.

The DC-6 arrived dead on time, and we discovered that the two airwomen in the lounge were no exception. Our own cabin crew was two pleasant and pretty young American girls with the spikiest of spike heels and sheerest of nylons.

Complement—55. Twenty less than capacity. Tourist density seating, backward-facing. All seats adjustable, pillows and blankets (if you needed one) provided in transparent envelopes. Iced-water fountain by the two rear toilets. And in-flight smoking both in cabin and crew quarters. Hot—and good—coffee with your "lunch."

Paris to the Azores (Lajes) is 1,411 miles. We arrived there about midnight Paris time, were out of the aircraft, into a bus and in the Officers' Club in no time. Organization was well on the ball. Take-off was delayed to let a V.I.P. aircraft go through. This was the "Epicurean" of the MATS Atlantic Division—"The Blue Plane." Forty-five seats—"And boy! The chow!" said a U.S.A.F. colonel.

Touch-down at Andrews Air Force Base was about 0945 hr East Coast time after another 2,417 miles. For some little while we had dithered over the pleasant Maryland countryside waiting for clearance while the U.S.A.F. showed off to Washington the latest fighter for the capital's protection. This was the Delta Dagger, the Convair F-102. As we taxied on to the unloading ramp a section of F-102s landed, parachutes streaming. Impressive indeed.

But MATS were hustling us. No time to talk about this supplement to the Nike batteries which encircle the capital except to learn the Dagger is *just* supersonic. The later F-106 is faster.

Through Customs and immigration with the minimum of fuss, though a notice told us: "This terminal is being rebuilt for *your* convenience." And as I stepped into the bus I regretted the dollar bill I had stuffed into an envelope at Orly when persuaded to do so by a U.S.A.F. officer. All passengers, whether military or civilians, can insure against accident. But they pay their own premiums by airmailing them to an insurance company in Omaha.

Into Washington for a shower and clean-up, past the wonderful cherry blossom which had just sprung into bloom. Around the Tidal Basin and the Jefferson Memorial the effect of these clouds of pink was fairy-like; and next day to the Pentagon, to hear Maj-Gen. Douglas Johnson, Deputy Director for Strategic Plans of the Joint Chiefs of Staff, tell us of the current military picture.

Some of his facts were not new—but to hear them given to us in the quiet conference room in this vast military headquarters was impressive, for around us worked the team of 30,000 people who administer and plan for the 250 U.S. military bases throughout the world.

Johnson's estimate of the armed forces of the Communist bloc is about 8,000,000 men. It includes 400 ground divisions, 500 submarines and 25,000 operational aircraft. At the height of World War 2 Germany and her allies had 400 divisions and almost severed our shipping lines with fewer than 100 submarines at sea. In fact, Germany began World War 2 with only 57 submarines.

The General believes that steady improvement in the Soviet long-range air force will continue. It can deliver high-yield nuclear weapons. And, above all, the Soviets have placed over-riding emphasis on technological research and development of new weapons.

In the United States Air Force, the General told us, manned aircraft will continue to provide the base for air power for a considerable period. Virtually all Strategic Air Command bomber wings will be jet-equipped in 1959, and in that year the Command will begin to show a missile capability [with Thor and Atlas]. Virtually all intercepter squadrons will be equipped with air-to-air guided missiles and a considerable number of squadrons will be equipped with the new nuclear-armed air-to-air missiles.

As we toured the building (every visitor gets a neat plan to show him how to reach his quarry) talk was all about the President's new plan for the forces. How would it affect the top brass—the men responsible for the operations of the Army, Navy and Air Force? Comment was generally favourable, that a joint planning and operational staff was a must in these atomic and pentomic days, that the Service departments should be purely housekeepers.

That, as it turned out next day, was exactly how Defense Secretary Neil McElroy put the picture to the Senate Armed Services Committee. I watched this capable man make his case in an atmosphere enough to daunt even Duncan Sandys—with his inquisitors ranged in a forbidding half-circle above him and the Press table almost knocking against the back of his chair. Beside him sat General Nathan Twining, chairman of the Joint Chiefs of Staff—non-smoking, like McElroy, while most of us were puffing away.

Opponents of the scheme believe that to put the operational use of the Services under one man smacks of dictatorship. But speed of decision—hopeless when three separate operational staffs have to do it—is so essential that it must come.

And that part of Eisenhower's plan which would give the Defense Secretary power to divert five to ten per cent of the military financial allocation as he wishes without the consent of Congress seems practical and wise. As I heard McElroy tell the committee, there may appear a sudden priority to proceed with one weapon while dropping another, or an urgent need of money to support operations of one Service in an emergency.

I hope McElroy wins. It is a scheme for creating a real overlord for defence which Duncan Sandys is—again I hope—watching very closely. That is my personal opinion; for it would do the very job which has needed urgent attention both in Britain and the United States ever since the end of the war. That is removing the petty jealousies, the lack of co-operation and the general confusion which happens too often when each Service is responsible for its own operational planning subject only to general policy planning by the political head of defence and his Service advisers.

Memo. for the War Office: In a glass case in one of the innumerable Pentagon corridors were some neat models of the Army's missiles. Two are shrouded like statues yet to be unveiled; they were labelled "Sergeant" and "Pershing."

Memo. for the Admiralty: Somewhere else in the Pentagon (I'd lent my compass to somebody, so I couldn't pin-point my position) there was a full-scale mock-up of the Rat, new anti-submarine missile. It's a good idea to let those chair-borne officers and civil servants in Whitehall see exactly what's going on.

Rat is impressive and will become operational with the fleet late this year. And it is interesting to note that the system can be installed in the majority of U.S. destroyers without much expense, by utilizing existing five-inch gun mountings and by slight modification of the search and fire-control systems already installed.

Now off to Philadelphia—again by courtesy of MATS. This time in a V.I.P. C-131B—a beautifully fitted-out Convair 340. Flying time from Bolling Air Force Base to Philadelphia International, 45 minutes.

Four-abreast seating—facing over large tables. Sofas and conference table in a rear cabin. Stewards this time—in impeccable white jackets, black bow-ties and black trousers. Both airmen, one a sergeant. It was another 75-cent lunch, which I had to bolt faster than I did on the Silver Wing on the way to Paris. We were over the threshold at Philadelphia before I got the last of my milk down my jacket.

Incidentally, about the only resemblance between MATS and Transport Command is that the aircraft *do* fly and that there is no liquor permitted aboard. "What," I asked one of the airwomen on the DC-6, "would you do if somebody came aboard a little tight or had a bottle of bourbon with him?"

Said the petite little blonde, built beautifully to area rule; "Throw him off."

EJECTION AT 56,000ft

AT the R.A.F. hospital at Halton last Friday the two R.A.F. officers who recently ejected from a Scorpion Canberra at 56,000ft over Derbyshire gave an account of their experience.

F/L. J. P. F. De Salis, the pilot, said that his stabilizing parachute was damaged by hitting something, with the result that he "started spinning very fast." His arms were thrown above his head and he could not get them down. He was not conscious all the time, but remembered his parachute opening at between 10,000 to 13,000ft—though if it had not opened automatically he would have been too muzzy to have done it himself. When it opened, the shroud lines were "wound up." F/L. De Salis estimated that he was spinning for 48,000ft—more than nine miles of the eleven-mile drop. "Afterwards I felt I had gone many rounds with a very heavy punching boxer." Although there were 97 deg of frost when the two men left the aircraft and this continued for 22,000ft of the fall, neither suffered more than minor frostbite.

F/L. P. Lowe, the navigator, said that he found himself coming down horizontally, face downwards, until his parachute opened. "The free fall lasted four minutes, but it seemed like a day and a half." Neither officer had made a parachute jump before. Both have now been declared fully fit.

UNIQUE products of the French private industry are these two. Above left, the Bréguet 940 STOL with four Turboméca Turmo II turboprops. Now ready for flight trials, it has a double-slotted trailing edge, and should take off in about 200ft at some 14,000 lb weight. Below, the first Morane Saulnier M.S.1500 Epervier light ground attack machine. It has a Turboméca Marcadau, but the production Epervier will have the more powerful Bastan.

THOR/VANGUARD TEST

AT 7.10 p.m. on April 23, the U.S.A.F. fired from Cape Canaveral a test vehicle consisting of a Thor IRBM carrying a modified Vanguard second-stage surmounted by a blunt re-entry nose section. The vehicle is reported to be similar to that which the Air Force intends to launch against the moon during the coming summer, but the firing was described as a re-entry test, the second stage being ignited after about two minutes' flight with the final strike aimed at a point some 6,300 statute miles away in the south Atlantic. It was later reported that the re-entry body carried a mouse, which perished owing to the point of impact being appreciably nearer to the launching than was originally programmed.

ELECTRAS FOR THE U.S. NAVY

THE U.S. Navy has ordered a large number of Lockheed Electras, for service as a Neptune replacement. The number ordered is not disclosed at the time of going to press, but is unofficially reported to be 80. The Electras, which will probably be designated P3V, will each carry a crew of 10 and a very wide range of electronic search and attack systems.

TAON RECORD

ON April 25, the first prototype Bréguet 1001 Taon established a new world 1,000 km closed-circuit record, homologated by the F.A.I. Flown by Bréguet's chief test pilot, M. Bernard Witt, the Taon took off from Istres at 6.21 p.m., flew to Cazaux and returned to Istres; the flight was made at 25,000ft and the distance took 57 min 23 sec, representing a speed of 1,045.65 km/hr (649.7 m.p.h.).

This performance, representing almost sonic speed for an hour, is particularly meritorious when it is remembered that the Taon is an extremely small attack aeroplane; the aircraft was by no means new, and was unmodified—except for the now-standard bulges at the wing roots. It was powered, like other 1001s, by a single Bristol Orpheus BOr.3 turbojet rated at 4,850 lb thrust. The Taon has been selected for development with the more powerful BOr.12 engine (6,810 lb dry) for use as the second-generation NATO attack aircraft.

HERE AND THERE

Moscow F.A.I. Conference

THE F.A.I. has accepted an invitation to hold its 1959 annual conference in Moscow.

Aircraft Industry Employment

DURING January this year, according to Ministry of Labour figures, the number of those employed in the "manufacture and repair" of aircraft was 256,400. The previous month's total was 257,600.

M.T.C.A. Appointment

MR. R. W. ELLIOTT, M.P., has been appointed Parliamentary Private Secretary to the Joint Parliamentary Secretaries to the Ministry of Transport and Civil Aviation, Mr. Richard Nugent and Mr. Airey Neave.

Ejection on the Air

A FEATURE programme giving an account of the invention, testing and development of the Martin-Baker ejection seat—under the title *Seat of Survival*—is to be broadcast in the B.B.C. Home Service this evening, May 2, at 7.30 p.m.

Vickers Factory Closure

EMPLOYING over 400 men, the Vickers-Supermarine factory at Trowbridge, Wilts, built in 1943, is to be closed this year. It is at present engaged on Scimitar components. The superintendent, Mr. S. P. Woodley, has stated that work is available at the Swindon factory for a proportion of those now employed at Trowbridge.

Down to Rio

BOUND for the Argentine to represent the Queen at the inauguration of Dr. Arturo Frondizi as President, the Secretary of State for Air, Mr. George Ward, left R.A.F. Lyneham by Comet 2 of No. 216 Sqn. on April 25. With two Vulcans of No. 83 Sqn. [see *Flight* for April 25, p. 588] the Comet is to take part in flying demonstrations marking the occasion.

Operation Eastabout

ON the first leg of its round-the-world journey the R.A.F. Canberra *Aries V* flew the 4,189 miles from Manston in Kent to Nairobi (Kenya) in 8 hr 12 min. It then reached Salisbury (Southern Rhodesia) on April 22 in just over ten hours' flying time from the U.K. Its flight to Nairobi was substantially faster than the existing record of 9 hr 55 min (set up by a Canberra in 1952), but no record is being claimed.

ROYAL VISIT: The Duke of Edinburgh, during his tour of Vickers-Armstrongs factories last Friday, leaving the first production Vanguard at Weybridge. Following him is Sir George Edwards. (News story, page 590.)

Jet Provost's Tour

AFTER being shipped to Trinidad, a Hunting Jet Provost is making a demonstration tour of eight South American countries. Starting this week and to go on until July, the itinerary includes Venezuela, Colombia, Ecuador, Peru, Chile, Argentina, Uruguay and Brazil. Distance flown will be some 7,000 miles.

For Movie Makers

OUR associated journal *Amateur Photographer* is publishing a special "Ciné Buyers' Guide" on May 7. Containing a complete illustrated survey of all available ciné cameras and projectors with helpful articles on the choice and use of them, it will be on sale at the usual price of 1s 3d.

Essayists Rewarded

AT their inaugural Christmas Lecture for Young People, given by Peter Twiss, Brough R.Ae.S. Branch launched an essay competition. The winners—John Hesslewood (17) and Kenneth Hudson (16)—have now received their prizes. Each was given a flight with Blackburn test pilot Dick Chandler and a book by John W. R. Taylor.

Utile Alouette

AS a result of tests carried out by the helicopter research and development department of Sud-Aviation, the Alouette II in its naval version can be equipped with inflatable pontoons without its cruising speed being affected. The department has also discovered uses for compressed air bled from the Turboméca Artouste shaft turbine of the Alouette, such as driving a pneumatic winch, which with this power weighs only 22 lb compared with 36 lb for the electric or hydraulic type.

Sud-Aviation Director

PREVIOUSLY assistant director-general, M. Louis Giusta has been nominated director-general of Sud-Aviation.

Furthering Plastics Research

EDUCATION and research in the field of plastics will be furthered by a donation of £1,000 made by the Associated Iliffe Press, Ltd., on behalf of *British Plastics*. A trust has been set up to administer the money, with Mr. H. V. Potter, Mr. C. C. Last and Mr. N. B. Punfield (all of the British Plastics Federation) and Mr. C. E. Wallis, chairman and managing director of Associated Iliffe Press, as trustees. The trust has the widest discretion as to the precise use to be made of the money within the general field of research and education.

London Film Evening

AT the next meeting of the London Society of Air-Britain (Caxton Hall, Westminster, May 7, 7 p.m.), Mr. W. E. Oliver, B.O.A.C. senior technical photographic officer, will introduce his wide-screen film *Hong Kong*, an aircrew-training film illustrating the approaches to Kai Tak under various weather conditions. He will also show a B.O.A.C. colour picture, *Tomorrow is Theirs*, and other films to be screened concern Westland Helicopters, Edwards A.F.B. and Wright Air Development Center. Visitors are welcomed.

ROLLING IT OUT: This long "fuel train," evolved by the special products department of the Goodyear Tire and Rubber Company's aviation division, transports 5,000 gallons, within its balloon tyres, over the roughest surfaces. It is being used by the United States Air Force.

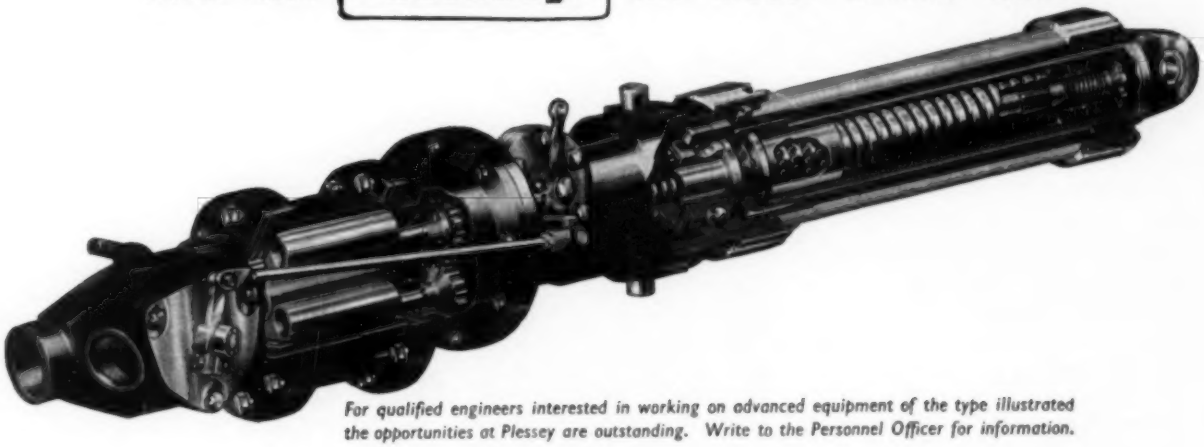
*Split second** reheat nozzle operation

Fully variable reheat demands rapid variation and accurate control of the area of the propelling nozzle. This Plessey Air-Motor ram will give a thrust of 5,000 lb., and complete a 5-inch stroke in less than one second with rapid reversal — essential where ambient temperature makes the use of hydraulic or electrical actuation hazardous or impracticable.

A wide range of Plessey Air-Motor powered rams is under development for contemporary aircraft. These have other applications such as Thrust Reversal and Thrust Deflection systems.

* 0.5 to 0.7 seconds for full stroke depending upon altitude.

with this Plessey Air-Motor driven Ram



For qualified engineers interested in working on advanced equipment of the type illustrated the opportunities at Plessey are outstanding. Write to the Personnel Officer for information.

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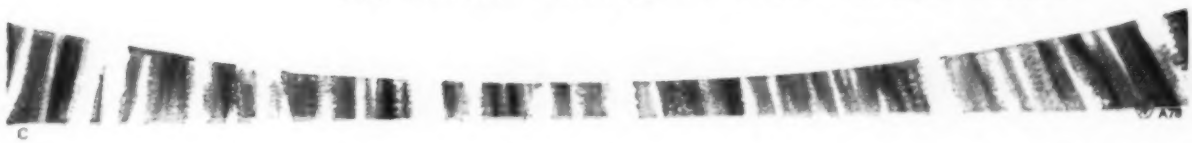

C

Development testing of a Rolls-Royce Tyne engine.

Progress in turbine engines calls for ever higher operating temperatures and creates incessant demands for more advanced heat-resisting materials. These demands are being met in every British aero gas turbine by the Nimonic Series of Alloys which retain great strength even at red heat. In the Tyne turbo-prop, which is to power the new Vickers Vanguard airliner fleet, Nimonic Alloys are specified for the turbine rotor blading and many other parts in contact with the hot gases.

NIMONIC

'NIMONIC' IS A REGISTERED TRADE MARK

ALLOYS

USED IN EVERY BRITISH AERO GAS TURBINE

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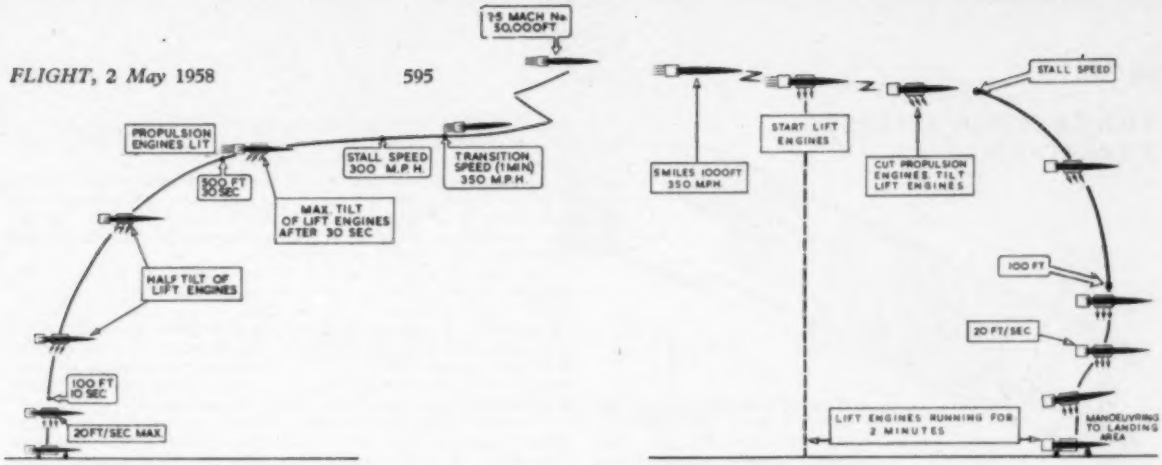


Suggested programmes for take-off and landing for a Griffith VTO airliner; comments on the procedures were published in Part 1 last week.

The Griffith Airliner Explained

A CRITICAL DIGEST OF DR. C. T. HEWSON'S R.Ae.S. LECTURE

PART 2

BY JAMES HAY STEVENS, A.F.R.Ae.S.

THIS is the conclusion of the article—Part 1 of which appeared last week—in which our contributor discusses points made by Dr. C. T. Hewson of Rolls-Royce, Ltd., in his Section Lecture to the Royal Aeronautical Society on April 15. The subject was Dr. A. A. Griffith's "supersonic VTOL dart" scheme.

THE speaker next dealt with the mechanics of engines and airframe, elaborating the guiding design principle which applies throughout the project—"optimization" as opposed to compromise. It is this which is the really radical aspect of the Griffith proposals; instead of compromising to make the features of the aircraft suitable for a range of conditions, each is designed to approach the ideal for its particular task.

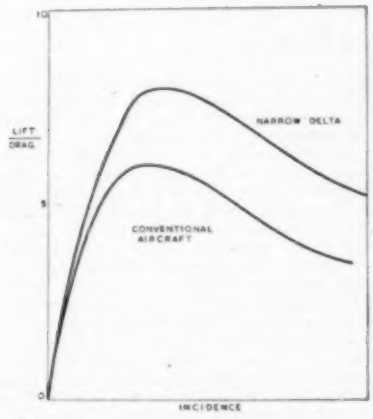
The RB.108 lift engines were designed for the lowest possible specific weight by making them to fit the lowest point of the square/cube law curve as put into practice by Rolls-Royce experience. This occurs at an engine diameter of about one foot, which achieves the minimum amount of material for the air mass-flow and pressures involved—anything smaller results in parts that are oversize to stress considerations. A specific weight of 0.1 lb/lb thrust appears feasible. Against this has to be set the colossal jet-lift fuel consumption, of approximately two per cent of the aircraft gross weight per minute, or about four per cent of the take-off gross weight for the three minutes of jet-supported flight; considerably less fuel is required for the descent, where the aircraft is lighter and the thrust rather less than the landing weight.

Stability and control while hovering—the corollary to the lift engine—was studied in parallel by Rolls-Royce, and was proved with the "Flying Bedstead" during 1953-54. In Dr. Hewson's words: "The stability of the 'Bedstead' in roll and pitch is maintained by an automatic control. Gyroscopes detect angular movement in terms of attitude and velocity. These signals are fed into an auto-stabilizer, which adjusts the control nozzles to give stable response to the pilot's requirements. The required control moment is given by an equation of the form $M = as + b\theta + c\dot{\theta}$; where M = control moment, s = stick movement, θ = angular displacement, $\dot{\theta}$ = angular velocity, a, b and c are constants. For a given moment of inertia and maximum control moment, b and c can be chosen to give satisfactory stability."

Height can be similarly treated, with the thrust/weight relationship as the control force and the aircraft mass in place of the moment of inertia. Dr. Hewson said that although with practice a pilot can keep the height of the "Bedstead" almost constant and can control the rate of descent, it should be realized that the degree of skill required approximates to driving two cars at a constant distance apart at 60 m.p.h. with only the accelerator pedal control. In the belief that height control must be an automatic function Rolls-Royce is developing a hovering device.

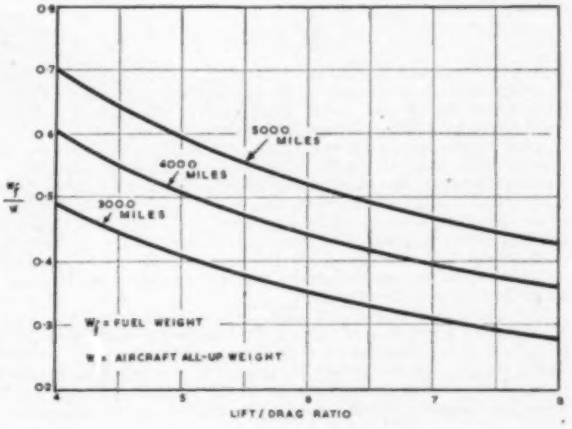
Dr. Hewson was unable to discuss transition other than to mention the Short SC-1; but it is evident that the "flat riser" has its own peculiar problems. The writer feels that the momentum drag of the inflowing jet-lift air, which as a linear flow must also interfere with the development of circulation lift in the Griffith configuration, is a critical factor of which the solution is as yet by no means certain. In the SC-1 with fuselage engines, one imagines interference with the development of circulation would be small. It would be impossible to accelerate from the jet-lift stage on the propulsion engines alone, hence the tilting lift engines and, one feels, something more in the nature of entertainment, such as a development of the jet flap, may become necessary to achieve circulation.

Examining the supersonic VTOL aircraft in comparison with a conventional one of similar performance, Dr. Hewson made the



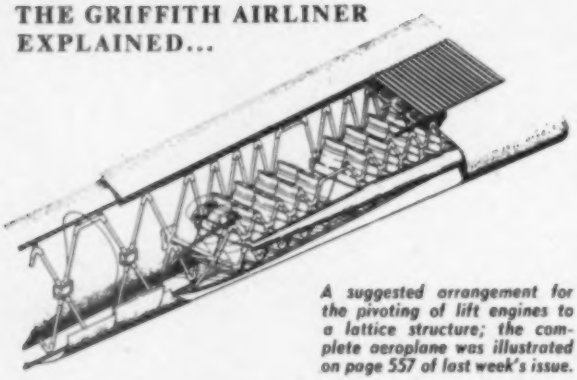
On the left are curves of L/D plotted against angle of attack (described as incidence) at high Mach numbers.

The curves on the right relate L/D to fuel requirement and range. These curves are discussed in col. 1 overleaf.



D

THE GRIFFITH AIRLINER EXPLAINED...



A suggested arrangement for the pivoting of lift engines to a lattice structure; the complete aeroplane was illustrated on page 557 of last week's issue.

following points, supported by some simple (perhaps even over-simplified) arithmetic:—

Propulsion fuel weight is a function of L/D, and Dr. Hewson produced a curve based upon M=2.6 cruising at 50,000ft with a specific of 1.5. From this it was suggested that, with a L/D of 6 (conventional), the fuel for a London - New York stage of 3,600 miles would be 41 per cent of the take-off weight, which was increased to 51 per cent for headwind/engine failure and stacking/diversion allowances of five per cent each. The VTOL propulsion engines were favoured with a specific of 1.4, because of the absence of silencers and thrust reversers, and the aircraft was considered to be immune from stacking or diversion (whatever the weather), so that the fuel weight would only be 31+5=36 per cent of the take-off weight.

Propulsion engine weight of the VTOL would also be less on a thrust basis, owing to the better L/D. As against 11.3 per cent for the conventional—which would be increased by 10 per cent of the engine weight to allow for silencers and reversers, to 12.5 per cent in practice—the VTOL propulsion should not exceed 8.5 per cent.

Structure weight of the conventional aircraft could be assumed to be 30 per cent, based on current practice. The VTOL shape, however, would be highly favourable structurally because of its physical depth. The cool pressure-cylinder, light because it has no stress-raising windows, could be the structural core, from which a light tubular lattice structure could be built to carry the engines and skin. At M=2.6 in the stratosphere the ram-air temperature would be 240 deg C, with an estimated equilibrium figure in the skin of 200 deg C. Dr. Hewson thought that in a relatively unstressed skin (where the design criterion might well be gust loading at take-off and landing) light alloys would be usable. There would be little turbulence at cruising altitudes and light alloys were already performing well under load at such temperatures in compressors. Aerodynamic control surfaces would be small (elevons), while differential operation of the propulsive jets could give yaw control, the stacked nacelles serving as fins. The take-off/landing cradles would obviate the need for an undercarriage. All of which suggested 14 per cent as a reasonable guess for the structure weight.

Equipment and crew, including a large-capacity cooling system, would be about eight per cent for both VTOL and conventional.

Lift-engine weight would be an additional 19.75 per cent for the VTOL. This figure would break down into: engine weight 11.25 per cent (10 per cent engine specific weight on 112.5 per cent take-off gross), mountings 1.125 per cent (10 per cent of engine weight), intake and exit shutters and controls 2.25 per cent (20 per cent engine weight), silencers 1.125 per cent (10 per cent engine weight) and lift fuel 4 per cent.

All this totals 86.25 per cent of the take-off gross weight for an Atlantic VTOL, leaving 13.75 per cent for payload—say 100 passengers in an aeroplane of 175,000 lb take-off weight. Against this, component weights of the runway-based aircraft totalled 101.5 per cent, without any payload!

Dr. Hewson wound up his talk by suggesting that a VTOL aircraft capable of flying between London and New York in two hours might not seem quite so much of a designer's dream as conventional thinking would indicate. He further re-emphasized that high dividends were obtainable by designing the main features within narrow performance limits; by neglecting low-speed requirements a very low drag shape resulted, and by tailoring the engines to their individual tasks their weight became very low.

Sidelights from the discussion served to show how far Rolls-Royce has studied this project. When questioned about unsilenced propulsion engines being lit at 1,000ft Dr. Hewson maintained that these would never be run at cacophonous take-off r.p.m., but at the "climb-out" rating to which a conventional aeroplane's engines would have been throttled at that height. Moreover, the VTOL aircraft being independent of wind direction one "could choose the people one wished to annoy, or, more seriously, the traffic lane would be a single one—ideally out to sea."

Operating costs of a large number of engines would certainly be high, but utilization could be phased so that for an overhaul life of 2,000 hours on the propulsion engines—a thousand Atlantic crossings—the lift engines had a 50-hour overhaul period. (A short-life engine should be a cheaper product in first cost.) Mr. Keith-Lucas suggested that there is a tendency for airframe and engine prices per pound weight to approach equality and Dr. Hewson's figures would make the VTOL aircraft cheaper, provided it were built in quantity so as to amortize the vast development costs. (It might here be pertinent to remark that only about a third of the number of M=2.6 airliners would be required for the same carrying capacity as conventional high subsonic types.) Dr. Hewson commented that the engine cost per pound rises as the specific weight falls, but the price per pound of thrust remains about constant.

Aerodrome temperature/altitude effects would have a similar effect on lift engines as on conventional ones and would have to be met by reducing the a.u.w. There was an admitted disadvantage in that there was no runway to lengthen, while the introduction of methanol/water injection (for 50 or more engines) would be "a problem."

Jet erosion is a problem—when the Ryan X-13 crossed a road it dug up the concrete and raised clouds of steam from a river—but the RB.108 is a small jet. The hot part of the efflux is the 10 deg central cone which, issuing from a 10in or 11in nozzle, would be thoroughly mixed after some ten feet, while the whole jet would be perhaps 200 to 300 deg C at twenty feet.

To sum up, one would say that this was a clear exposition of a radical project—albeit there are still several unanswered queries which even the discussion failed to elucidate. As a means of getting long-range M=2 plus military aircraft relatively safely on and off the ground (with the minimum infrastructure as an operational bonus) it seems full of promise—if the transition problems prove soluble. Viewed another way, it could be the only answer to providing a 5,000 mile M=2.6 bomber, or a supersonic low-level strike aircraft. However, despite Dr. Hewson's plea that we must learn to trust more in electronics (automatic stability and descent) and his arguments on the all-weather virtues of the approach-path (which one has suggested are fallible), the prospect of packaged passengers fills one with claustrophobic horror—it sounds too nearly like being a cocktail in a shaker.

HANDLING OF LARGE MISSILES

IN the last of the British Interplanetary Society's current programme of lectures some problems of handling large missiles were discussed by Mr. F. R. Forbes Taylor, chairman of the Reed Crane and Hoist Company of Bristol.

After saying that he did not see that missiles would be any more delicate than some of the loads normally handled by cranes, the lecturer surveyed the devices that the handling engineer had at his disposal: with goliath cranes and similar large machines, loads of say 200 tons, in units 150ft long, could be handled, set on end, and accurately positioned. Turning more specifically to rockets, the lecturer said that the majority of the smaller current tactical weapons could be handled easily, and most interest lay in automatic loading gear for launchers.

For larger future vehicles (Mr. Forbes Taylor had in mind Von Braun's space-ship of some 5,000 tons empty mass) the complications of erecting the assembly after completing it in a horizontal position seemed to be very great, and it would be necessary to build the vehicle on its launcher, in the vertical position. Such a procedure meant that the motors, for example, would have to be installed first instead of last, unless hatchways through the tanks could be provided, and the time necessary would be longer: it would be very difficult to have large numbers of men at work simultaneously around a vertically positioned vehicle.

Looking still farther into the future, the lecturer said that he had considered whether it would be possible to build a crane capable of assembling a vehicle 400ft high in units of 1,000 tons each. A wheeled crane running on tracks at ground level would be almost impracticable: it would need 64 wheels to carry it, and would cost about £3 million. If the vehicle builder were prepared to alter his firing site to make the assembly easier, then a 1,000-ton overhead travelling crane, running on fairly low concrete walls, could be built without difficulty; but such a crane would have to assemble the vehicle in a deep pit, from which it would be launched. Such an arrangement would complicate the launching procedure, but (as was pointed out in the discussion) the British IRBM is believed to be intended for underground launching, and more knowledge of the problems involved might be available by the time the large vehicle was contemplated seriously.

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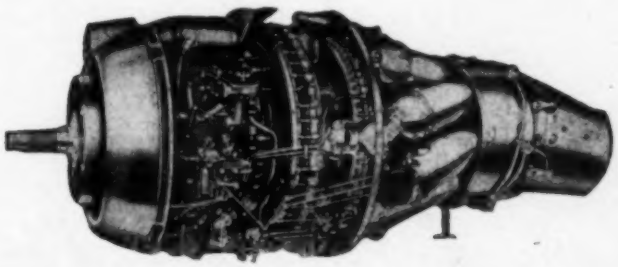

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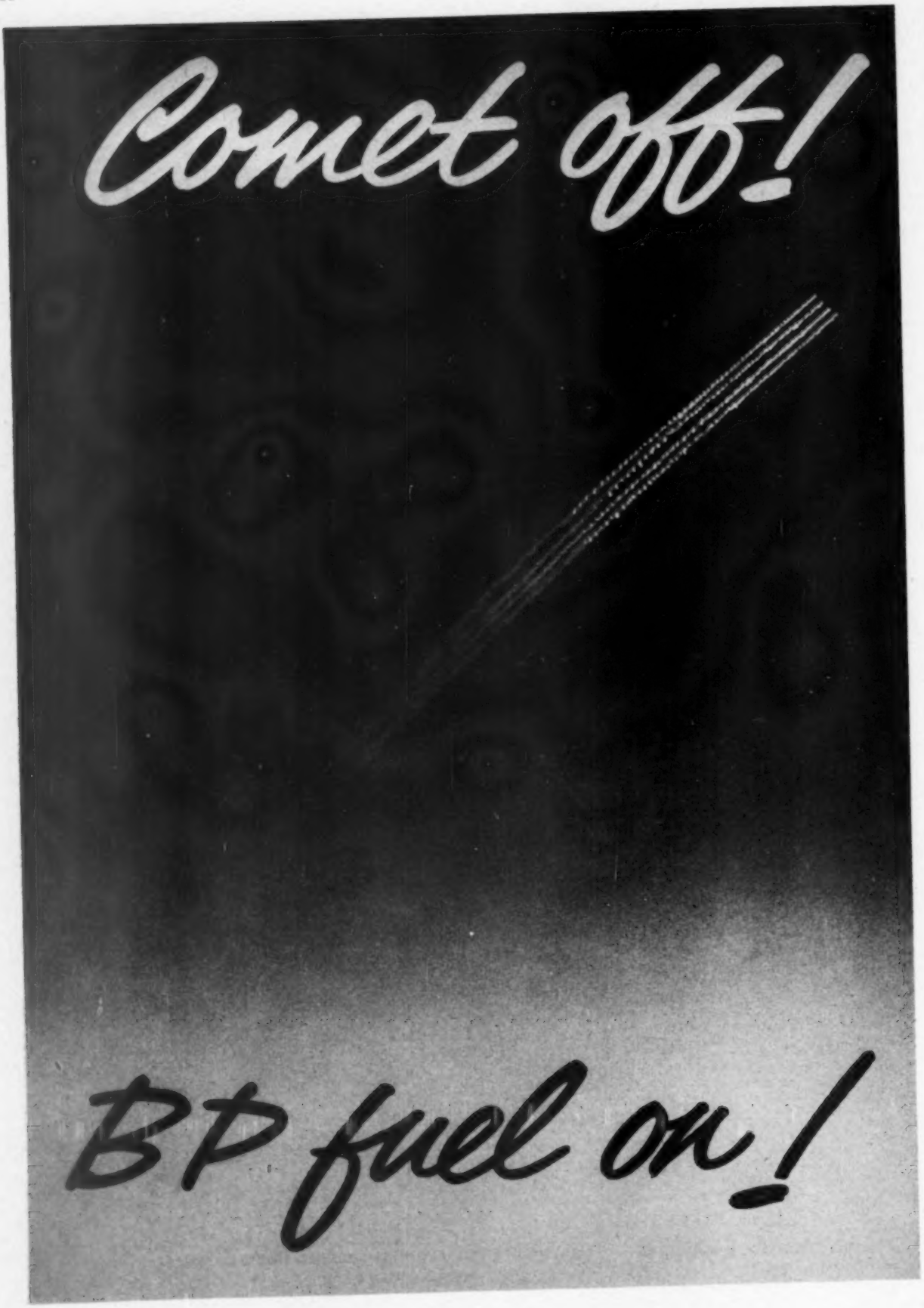
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Electrical Systems in the Air

AN ENGINEER STICKS TO HIS VIEWS

By LIONEL G. HILL, D.F.H.

IN the second part of the article "Aircraft Electrical Systems" (page 152, *Flight*, January 31), which referred to the papers and discussions at the May 1956 I.E.E. Convention, there appeared the significant phrase "... and if the speakers adhere to the views then expressed." This certainly calls for an answer.

I cannot, of course, speak for others, but, for myself I most certainly adhere to the opinions then expressed—with, if I may say, even greater emphasis in view of the events and trends since that time. In the succeeding two years with the aircraft industry I have been amazed not only at the lack of sound *fundamental* knowledge of A.C. systems and practice within the industry, but at the no less significant lack of similar knowledge on the part of quite responsible established electrical companies and component manufacturers who are foisting on to the industry electrical systems which are basically unsound.

The writer of the earlier article appears to be "sold"—like many others both here and in the U.S.A.—on the paralleled three-phase A.C. system. Let us briefly examine the fundamentals of such practice and, in particular, the systems described in the papers at the symposium which, we are told, have been applied *successfully* (the italics are mine) in British and American military aircraft.

"... in step and ... will equally share the ... loads"

Fundamentally we require a supply from four alternators on to a common busbar. For this it is essential that (a) the alternators shall all operate at the same frequency (i.e., speed), (b) that they shall be in step with each other and (c) that they will equally share both the real and reactive loads. Since the alternators are being driven from aircraft engines which run at varying speeds, an infinitely variable gearbox plus regulator—to wit, a torque convertor—must be interposed between the engine and the alternator. Here we meet our first big problem.

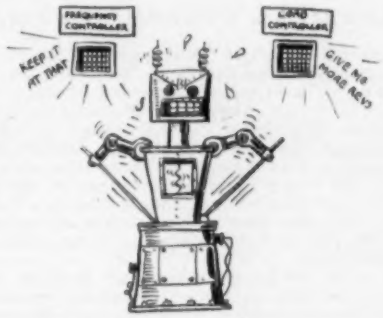
In a major power station some 95 per cent of the output of a turbine is used to drive the alternator and, when this is in parallel with other alternators, any tendency to get out of step results in the flow of circulating currents in the erring alternator which motor it to pull the turbine back into step. That is to say, in such systems alternators in step are virtually locked together electrically and it takes a major fault to unlock them. Now can you imagine a little aircraft alternator, absorbing something less than 5 per cent of the engine output, motoring back into step an aircraft engine which has made up its mind to go faster or slower? This is what it will have to do if the torque convertor is a positive drive; and for this reason mechanical torque convertors, such as the Hayes transmission, are completely unsuitable. Hydraulic torque convertors, however, can have a degree of slip built into them, so creating a "soft" drive and in this way maintain a semblance of inherent self-synchronizing. But here is the rub! If they are too soft they will not be able to keep the alternators in step under load transients. That is to say, they must be soft enough to keep in step over small engine speed variations but "stiff" enough to hold in under alternator transient load conditions. These limits are much closer than one would think and upon their maintenance stands or falls synchronized operation.

The second requirement is to maintain accurate frequency within close limits. This is, of course, a function of governing which is basically effected by a mechanical governor on the torque convertor. As this is far too coarse for aircraft electrical requirements it is usual to supply an electrically operated sensitive control which, in the Sundstrand, is a motor-operated spring bias on the governor using as its two references the output voltage of the alternator and a constant-frequency reference. Even so it is difficult to maintain close frequency control on four separate alternators when, as in the scheme described at the symposium, four separate references are used. But it is not an insuperable problem.

The third requirement, however, gets us into very deep water. Real load-sharing between the alternators is governed by the fundamental law that what you take out of the alternator must be put in at the prime mover. In short, real load-sharing must be referenced back to the throttle of the prime mover.

This is obviously impossible in an aircraft engine. The only thing to do is to temporize. If we assume that the prime mover can take any variations in load by a change of only one or two revolutions per minute, this can be compensated for by a slight adjustment on the speed regulator. So we reference our load-sharing back to the bias control.

But hold hard. This is also being regulated by the frequency control. It is therefore getting two messages—one from the frequency controller, which says in effect "Hold it at that, boy" and another from the load sharing circuit, "Give us a couple more revs, I'm slipping." What's a poor governor to do?



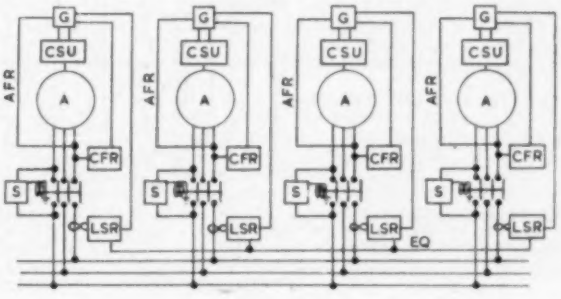
"It is therefore getting two messages . . . What's a poor governor to do?"

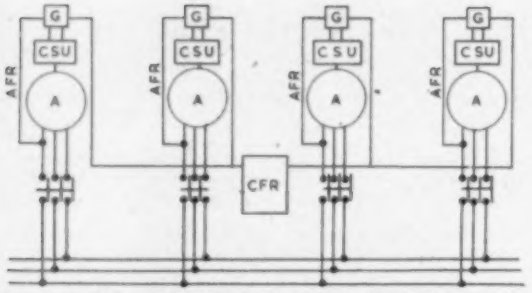
However, even this is not too bad. If we take it a stage further we come to the next fundamental, which is that alternators (or generators for that matter) running at the same speed and voltage automatically share the load provided that they have the same characteristics. With four such alternators load-sharing and frequency signals will be identical except that the frequency signal will *result* from a drop in speed whereas the load signal will anticipate the drop in speed. Unfortunately, alternators built to the same specification rarely have identical characteristics. There is always a manufacting tolerance. For absolutely matched *load* conditions each will require to run at a slightly different speed, will produce a supply at a different frequency and consequently will be entirely unsuitable for parallel operation unless made up into matched sets after production. Any subsequent change on an aircraft would involve all four alternators. Unmatched alternators on such systems can produce only gross instability.

It is therefore apparent that three-phase paralleled A.C. systems are not *fundamentally* suitable for aircraft use and they can only be "bodged"—I use the word advisedly—into operational systems by the incorporation of a host of palliative gadgets and circuits which are not only complex but, at the best, unreliable.

But, you will say, these are in use on American aircraft. Well yes, in use—but how? My information is that they are being operated for the best part of the time unparalleled. I am also prepared to wager that even then they are not fully stable, and that, before long, these aircraft will be in very real trouble with their electrical systems, trouble that stems not from design detail, but reaches down right to these basic principles. [*Contd. overleaf*

Typical four-alternator, frequency-controlled, load-sharing and auto-synchronizing circuit. A, alternator; G, governor; S, synchronizer; EQ, equalizing line; AFR, alternator frequency reference; CFR, constant-frequency reference; LSR, load-sharing reference; CSU, constant-speed unit. "Now let us be constructive for a change" (see overleaf).





Same alternators controlled from a common constant-frequency reference. (". . . What a clearance of gadgetry that will be!")

ELECTRICAL SYSTEMS IN THE AIR . . .

Supposing I am right. What can they do other than strip the whole system out and replace it? Well, let us be constructive for a change. If we scrap the individual frequency references, the synchronizing circuits and the load-sharing devices (phew! what a clearance of gadgetry that will be) and we reference all four sensitive governor controls to a single constant-frequency reference, such as a tuning-fork generator, then, since all must then keep in step with the reference they must all stay in synchronism and at the same frequency regardless of whether they are paralleled or not; and, since they are at the same speed, they will equally share the load within a kilowatt or so according to the degree of mismatching.

But we are still not out of the wood. Reactive load-sharing is a function of voltage regulation via equalizing lines on a similar plan to D.C. load equalization. Unfortunately, while on a D.C. system we have only one "phase" to monitor, on a three-phase system there are three. Which shall we monitor? Shall we use one phase as we do on inverter circuits or shall we average the volts from all three phases? Unless we have balanced three-phase loads—and who has on an aircraft?—we shall not keep more than one phase within the required voltage limits. One American proposal includes an overriding "highest voltage" reference with a mag-amplifier control circuit, but I still fail to see how it is possible even with this to share reactive loads equally on all three phases from a single alternator field control. On conventional power-supply systems this problem does not arise, because distribution engineers are constantly monitoring the loads and, where great out-of-balance exists, the single-phase loads are transferred to other phases on a broad pattern—with the overall result that, at the alternator, the disparity of current on different phases is very small. On aircraft systems there may, on occasions, be as much as 50 per cent difference between the reactive currents in different phases under which condition reactive load-sharing becomes a farce.

Let us assume that the impossible has been achieved. Are we out of the wood? Not on your life. Take protection. Merz Price systems have been lifted willy-nilly from power distribution and applied to aircraft systems. But these depend for their operation on a return fault-path outside the normal distribution feeders. In a three-phase delta E.H.T. system it is the earth via a dummy earth point in the transformer. In a domestic distribution system it is the earth, since the out-of-balance current from mixed three-phase and single-phase systems is returned via the neutral. This must be earthed only at the sub-station. In an aircraft the neutral and the earth are one and the same, the aircraft structure. How then can a relay discriminate between a real fault and an out-of-balance current? Merz Price and similar balance protective systems were designed for use on long transmission lines. They have no real justification in an aircraft system, where overload is the only fault condition to guard against.

Take another aspect. A three-phase motor may find itself "two-phasing" through a feeder fault some distance back. It will run on two phases with some overheating. The danger here is that it will impress, through transformer action, a voltage at some odd phase displacement, on to the third phase and, via the feeders, probably back to some other equipment such as an electronic navigational device, autopilot, etc., which is acutely phase-conscious and so give misleading information until the fault is discovered. This is no theoretical supposition. It really can happen and results could be disastrous. I could go on indefinitely, but space forbids.

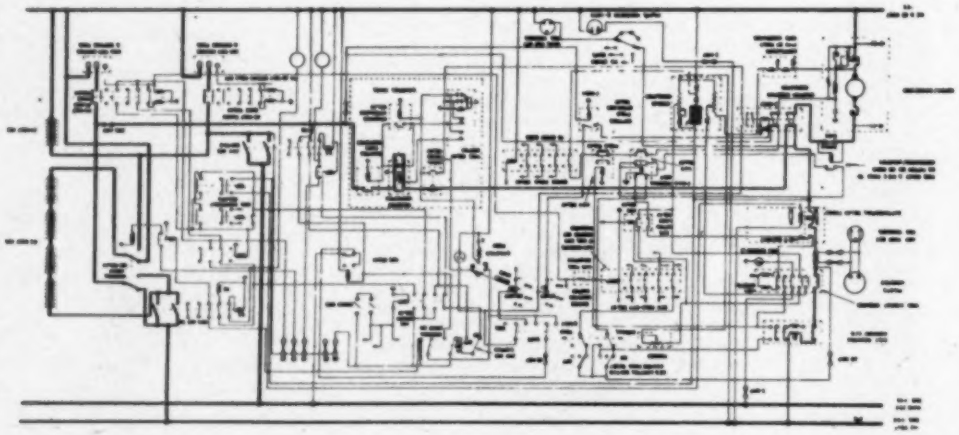
What, then, of rectified A.C. systems? One has only to look at the diagrams presented with the papers at the symposium to find the answer. Mag-amplifiers galore, compounding, cross-compounding, stabilizing and a host of other circuits all shrieking that the systems are full of palliatives for bad fundamental design. If we compare the systems as they were installed in the aircraft with those originally projected as "paper designs," the difference is amazing. The realities are far more complex since many of these "palliatives" have been introduced in the laboratory and development stages to cover just those shortcomings and, all too often, fundamental inadequacies in the original design.

What are the basic problems? First, to achieve within the imposed weight and space limitations an output from an alternator over a speed range which governs both alternator and its exciter. That is to say, the exciter must be able to generate full alternator load field current at the lowest speed range and yet be able to maintain stability at no load on the alternator at maximum speed. On any alternator this is a tall bill to fill. On the limited parameters of an aircraft installation it is practically impossible of attainment. So we introduce compounding and stabilizing; we try out different types of regulator and all too often we are forced to cut our losses by deleting the exciter and using a regulated voltage D.C. reference supply for excitation. Since this is, on an all A.C. system, usually from the rectified output of the alternator, we have to add a permanent-magnet generator for starting up.

As for the rectifiers, first we use selenium, which usually fails on open circuit, then we transfer to germanium and silicon diodes, which fail on short circuit. Though the first is safest it carries a penalty of vast forced-cooling fans and ducts. Germanium and silicon diodes, for safety, are being run at less than 50 per cent of their rated capacity and, even then, are having to impose on all electronic components in the system a completely unacceptable limitation on voltage transients which a D.C. generator would have taken in its stride. To say that the system, in the environmental conditions of an aircraft, is vulnerable is the very least of the criticisms.

The contributor of the original article mentions the starter generator. Maybe he doesn't know that the project to which he refers has proved a failure. Starter generators have always been recognized as a poor compromise between the optimum performances of separate generators and starters within the same frame size. In aircraft compromises cannot be allowed. Weights, space availabilities and torque and load requirement are all against it. Is it not significant that in the automobile industry, where such limitations did not exist, the starter generator went out soon after the bull-nosed Morris? And have you seen a generator starter circuit?

*". . . and have you seen a generator starter circuit?" (There are four of these on a four-engined aircraft.)**



**Mr. Hill's intimidating example is reproduced at this size on the assumption that nobody could possibly have either the time or the inclination to study it closely—Ed.*

As to variable-speed alternators, there is nothing new in the asynchronous induction machine. It is over thirty years old. It has a disadvantage in that the range of speeds over which it will maintain constant frequency output is very limited—far too limited for aircraft use. Unless this can be extended—and present indications give little hope for optimism—it is useless and contributes nothing to what has already long been known about the machine.

Fundamentally there is nothing in an aircraft system which justifies the use of three-phase A.C. Where space is limited and high starting torques on small motors are required, then D.C. stands supreme. This has been proven indisputably on rail-traction schemes. Even with overhead A.C. lines the current is rectified before being applied to the motors. By all means let us have higher generated voltages but for the maximum load needed on the largest of aircraft there is no need to exceed 112 volts, which in only very exceptional cases can cause physical hurt through shock. For the A.C. requirement of electronic equipment, single-phase supplies avoid all problems of differing voltages on phases and cross-phasing. Gyro motors will run just as well on single-phase as on three-phase. *Fundamentally* it is the right system for the particular field of application.

Why, then, are we shy of using it? There appear to be two objections. First, the output of an alternator is far greater than that of a generator within the same frame size. Second, there is the brush-wear problem, on which I have already commented at the symposium.

The first is valid but I am certain that a redesign of the generator on an inverted basis is possible which could almost, if not quite, meet the equivalent output D.C. of the alternator. Development costs? Let us say £100,000. Chances of success? Extremely high. The second has been within an ace of solution in many research programmes which have been prematurely cut without valid technical reasons. The commutator has not changed either in construction or design over the last 50 years, not because it is incapable of being improved upon but because it has so far satisfied the bill. But that is not to say it cannot be improved. Let us put the development cost at £50,000.

For £150,000—and this is a realistic outside figure to a determined development group—the objections to the D.C. system could be removed. (Compare this with the millions of British and American public money spent on A.C. system development.) It has already been established that the 115 volt D.C. system works and works well. Consider the Valiant. This, as the chief electrical engineer of Vickers-Armstrongs recently said before a distinguished American audience, "is an exercise in forward design which has contributed much to our present-day knowledge and practice and its influence has been felt not only in subsequent military aircraft but in civil airliners both current and future." That is a fully justified remark. Electrically the Valiant is one of the most reliable military machines in any country. Of course, some "clangers" were dropped during its development and the lessons properly and truly learned; but, compared with those on rectified A.C. and paralleled A.C. systems both past and current, they are as the tinkling of a bicycle bell to a full-blown peal. It seems such a pity to waste this valuable knowledge.

Now why should this be? So far as I can see, British aircraft designers are largely governed in their choice of system by the airline operators. They, in turn, in this country, being a nationalized industry, are advised by the Ministry of Supply who, in turn, are advised by the R.A.E., who, in turn, are influenced by NATO decisions which tend towards the acceptance of American standards, right or wrong. In this sort of business the Gadarene swine have nothing on the aircraft industry. Yet we have, if we care to exercise it, the aptitude and the technical knowledge to stand four square on our own feet.

". . . as the tinkling of a bicycle bell to a full-blown peal."

* * *

Now on a personal note. One of the symposium authors in his reply asked: "Are all the aircraft electrical engineers except Mr. Hill out of step?" Even if this were true the answer is still "Could be!" Gallileo, in his time and place, was the only one who insisted that the world was round. But that did not make it flat.

In matters of fact majority opinions just don't count. However, I am by no means the first or the only one who holds to these views, otherwise the Valiant system would never have seen light. It has not been my practice constantly to blossom forth into print or to read papers before learned societies; but for more than thirty years I have been closely associated with electrical technical and design matters in every field, both A.C. and D.C., from the highest voltages to the lowest, and I have clung all the while to sound fundamental precepts. I think I may claim to have a fair knowledge as to which supplies are most suitable for which services. In my own small sphere I have a reputation for being right far more often than being wrong. I wish the same could be said for many who hold responsible positions in the industry today.

Well, those are my personal views and I intend to stick to them.

To borrow a phrase from the old Western pictures, "Them's fighting words," and I may be taken to task for uttering them; but, seriously, matters are now far too critical for personal considerations to count. Both in Great Britain and America the future of the aircraft industry—with its tens of thousands of workers, its millions of capital, most of it held by small investors

"Them's fighting words!"

—and, above all, the safety of air travellers of all ranks and ages, will depend upon the cool and accurate judgment—I might add *selfless* judgment—of those who now hold the reins. A decision for political reasons, leading to a false selection of a wrong system can mean, at the very least, long delays in the delivery of an aircraft urgently needed to compete in the world's markets or, worse, an even longer record of unserviceability with the airlines. Possibly, since aircraft systems are today inextricably tied with air safety, it may lead to disaster.

I am practically certain that unless the industry shows a remarkable change of heart and is prepared to sacrifice gimmicks to sound fundamental design it will not need the foregoing views; but at least, for once, they are on record.

EXPERIMENTAL AERODYNAMICS TRAINING

NOW in its second year of operation, the Training Center for Experimental Aerodynamics (T.C.E.A.) at Rhode-Saint-Genèse in Belgium was established to train scientists and engineers from NATO countries in the techniques and operation of a modern aerodynamics laboratory and also to disseminate information on aerodynamics and related subjects.

So far, students from eleven NATO countries have taken the course. It lasts nine months, starting on October 15 and ending on July 15, and includes the following aspects of study: wind tunnels and basic instrumentation; basic electronics; measurements in steady and in non-steady flow; and transonic and hypersonic aerodynamics. The present aerodynamic facilities consist of two wind tunnels, one supersonic and the other low-speed; and it is planned to increase these facilities so as to cover the whole speed range up to hypersonic. There are also electronic, optical and photographic laboratories and shops for metal and wood machining. The electronic laboratory has a wide range of instruments for studying and developing equipment used in aerodynamic tests; and the optical one is equipped to cope with most problems encountered in the photographic and film recording of aerodynamic phenomena, and to develop devices such as the Schlieren systems.

The chairman of the directing board of T.C.E.A. is Professor Theodore von Karman, the technical director is Dr. R. Paul Harrington and there is a total staff of about 50. Scientists of international repute are invited throughout the year to give lectures and demonstrations.

There is no tuition fee for the course but those wishing to take it must have a B.Sc. in engineering, science or mathematics (or the French or U.S. equivalent degree) and a knowledge of incompressible and compressible fluid mechanics; while some knowledge of basic electronics is desirable. A limited number of scholarships is available; tuition is in both English and French; and at the conclusion of their course successful students are awarded certificates. Application forms and further information may be obtained by writing to the Technical Director, Training Center for Experimental Aerodynamics, 72 Chaussée de Waterloo, Rhode-Saint-Genèse, Belgium.

CUCKOO IN THE NEST

S/L. Paton talks it over with E. J. Connellan, governing director of Connellan Airways. Behind is "Jumbo" Goddard, recently back at Alice Springs after crossing the Atlantic in "Mayflower."

By G. E. C. ARCHER

IT was midday in the Alice, with the mercury slowly groping its way towards the nineties and the old lubra outside Fogarty's Store nodding amongst a cloud of flies, when suddenly the peace and quiet was shattered by the roar of twin jets, and a Canberra flew overhead. Not only was it lower than usual, but had wheels and flaps down. Not strange you say? No indeed, for we have two airfields in the Alice; but the one that jets use is some seven miles to the south, and we seldom see them over the town. During the next few seconds it became increasingly obvious that the bomber was heading for the little Townsite Airfield, home of Connellan Airways, scenically situated against the McDonald Ranges, and used exclusively by the lightplanes of that operator.

And now the scene changes to the airfield itself, where the staff are preparing to sign off for the lunch break, when literally out of the blue drops this strange visitor, heading for the newest and longest runway—as yet not open to our aircraft, for the surface is still soft. Before anyone can do anything the bomber is down safely, and rolling along in its own private cloud of dust. Safe and sound—but very much on the wrong airfield.

To say that "alarums and excursions" followed is to put it mildly. The shaken crew descended, the pilot faced with that awful moment (which all of us hope will never come our way), that of having landed at the wrong airfield. When informed that we would have reluctantly to inform his C.O. of the situation, he replied that it wouldn't be necessary, as he was in fact the squadron C.O. "Tell it not in Gath, publish it not . . ." etc.! The wires and atmosphere buzzed and hummed as messages and counter-messages flashed hither and yon, till eventually things quietened down.

Having got the bomber in, it eventually behoved the pilot to get it out again. So a survey of the situation was made, and it was decided that it would be practicable to take off the following morning at first light, on the next-longest runway. This was a firm strip, though albeit of loose sand and gravel. Some 1,150 yards long, it lies north and south, and heads towards the steep slopes of the McDonald Ranges. At the crucial spot in the surroundings, however, Nature has placed a gap—Heavytree Gap—through which winds the South Road, the railway, and the "river" Todd. The end of the runway is about 1½ miles from the Gap and from its end runs a dirt road, used by the towing car of the local gliding club in order to get a longer tow. It was decided that, by removing the boundary fence, this road would effectively lengthen the run available. That same afternoon, a willing gang of helpers removed all loose stones and sticks from the strip, in order to minimize the danger to the Canberra's intakes. This done, darkness descended on the scene.

At first light next morning, an expectant crowd gathered hopefully to see the spectacle of a jet bomber getting itself out of Connellan's Airfield. Among the Cessnas, Beechcraft, our beloved Rapide and mixed bag of Tigers, the Canberra certainly looked a cuckoo in the nest. The pilot had decided to do the take-off solo; with little fuel on board, he reckoned it was a fair go.

The Avons were started, and a stream of hot gases poured across the road, taking with it a gigantic cloud of red dust, which, rising a few feet into the air, got trapped by the early morning inversion, and so spread like a blanket over the town. As take-off power was selected the cloud grew thicker and thicker, boiling and surging up behind the machine like a minor atomic explosion. At the same time the thunderous roar of the twin jets reverberated round the hills. At the far end of the strip a car had stirred up a small cloud of bulldust, and this hung over the latter half of the strip, looking like a further hazard to the venture.

Undaunted, the pilot released the brakes and, like a silver rocket, the bomber was off down the strip, followed by the ever increasing cloud of fiery dust. As the two clouds merged the bomber was lost to sight, and only the fiendish noise coming from the interior of the dust-storm betokened the fact that the machine was still rolling.

Suddenly, like a phœnix arising from its own ashes, the silver form of the bomber shot out of the cloud, silhouetted momentarily against the Gap, then climbed steeply into the pale green morning sky. As the thunder of the jets rolled around the heavens, the aircraft headed for the Seven-Mile Airfield, and the crowd at Connellan's relaxed. The cuckoo had flown; history had been made at the Townsite Airfield; and as the dust settled the day's work began with preparing the morning mailplane for its scheduled departure.

* * *

Later, at the Seven-Mile, I talked to S/L. Paton, the Canberra's pilot. He reckoned that he had made the take-off in 550 yd, a mere half of the strip available. A first-class effort, though there must have been a few anxious moments. I know from experience that the Gap at the end of that strip comes up at an alarming rate, even in a slow aircraft. It is an illusion one could well do without; in a jet, it must have been terrifying.

S/L. Paton was on a flight from Laverton, Victoria, where he commands an R.A.F. Canberra detachment. He was to refuel at the Alice, and proceed on to Darwin. It was his first trip to the Centre, and with only one airfield shown on the map he made the understandable mistake of landing at the obvious place. The Seven-Mile, with its black bitumen runways surrounded by grass, becomes completely invisible at certain sun angles; throw across that a few midday cu shadows, and it is indeed hard to see, even if you know where to look. On the other hand, the Townsite has yellowish gravel runways that stand out well under all conditions, and the field is near to the town, where one would expect to find the airfield to Alice Springs. Lucky indeed was it that the new runway had recently been completed, and lucky, too, that the horse fence that had been across the middle of the strip had been taken down but a few days previously.

Now, when the D.C.A. leer at our pocket-size airfield we can retort that if it is good enough for Canberras surely it should be good enough for them. Anyhow, the inhabitants of the Alice are eternally grateful to S/L. Paton for giving them a new topic of conversation, if only for a day or two. Drought and cattle could do with a rest.

ANOTHER HIGH-SPEED BALE-OUT

AFTER a fortnight in hospital with multiple injuries, Leo Colapietro, Douglas test pilot, was able to give some details of his recent escape from an F4D Skyray at a speed reported to have been 650 m.p.h. He described his experiences after ejection as ". . . one climax after another. My helmet and oxygen mask were ripped off, then my gloves and wristwatch went. My clothes started to tear. I was spinning wildly, but I remember giving a sigh of relief when I saw that parachute canopy blossom out. I hit the water pretty hard and my 'chute began dragging me down, but I took a deep breath, put my face under the water and used both arms together to get at the toggles to inflate my life vest." Colapietro was picked up after 45 minutes by the U.S. Coast Guard; and it was then found that he had a broken arm, a dislocated shoulder and two black eyes.

North American test pilot George Smith, ejected from an F-100 at over Mach 1 at about 6,000ft in 1956, suffered severe internal and eye injuries. He spent many months in hospital, but has now been flying F-100s again for some time.

TO SAVE TIME AND LABOUR

WITH a total number of exhibitors approaching 300, this year's Mechanical Handling Exhibition—to be held at Earls Court, London, from May 7 to 17—will be the largest display of labour-aiding equipment and methods ever shown under one roof.

The exhibition, occupying over 500,000 sq ft of floor space, will for the first time be international in character—exhibitors from Great Britain, the United States, France, Germany, Italy and Scandinavia displaying thousands of time- and cost-saving devices. At the same time, at the Materials Handling Convention, leading authorities will present papers dealing with the latest methods.

Held every other year, the Mechanical Handling Exhibition is organized by our associated journal *Mechanical Handling*, with the full support of the five principal Trade Associations. Further information, details of the many facilities available to visitors, and tickets, can be obtained from the Exhibition Manager, Dorset House, Stamford Street, London, S.E.1.

A complete guide to the exhibits is contained in the London Exhibition Preview number of *Mechanical Handling*, now on sale.

The world over more aircraft land on Goodyear tyres, wheels and brakes than on any other kind

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Goodyear tyres, wheels, brakes and control equipment are specified for The Herald.

GOODYEAR AVIATION DIVISION

SERVING AVIATION THE WORLD OVER

Britannias get the green light

The U.S. Civil Aeronautics Authority yesterday passed the Bristol Britannia airliner for operation by American airlines. The first licence was handed over at Filton, Bristol.

Daily EXPRESS

U.S. CERTIFICATE FOR BRISTOL BRITANNIA

FROM OUR AERONAUTICAL CORRESPONDENT

The way was cleared yesterday for the Bristol Britannia turbo-prop airliner to be used on United States domestic routes, when a representative of the United States Civil Aeronautics Administration handed over to Dr. A. E. Russell, chief engineer of Bristol Aircraft, the American type certificate for the first of the Britannias ordered by Northeast Airlines.

The American certificate was granted after completion of certain modifications to the aircraft in order to meet the requirements laid down by the C.A.A., which differ in several respects from those of the British Air Registration Board. These must be satisfied before an aircraft can be put into domestic service by an American operator.

Deliveries of the five Britannias to Northeast Airlines are due to be completed during September and October. It is possible that the first, which is now ready for delivery, may be handed over ahead of time in order to give Northeast Airlines additional time for route proving flights and crew training.

The TIMES

SMITHS *congratulate Bristols*

on gaining C.A.A. Approval

for the Britannia 305 and are proud to have fitted

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CROP CONTROL

By CAPTAIN R. BRADBURY

THE purpose of this article is to set down some fundamental facts about the choice of equipment and examine the problems which face the grower and operator. The author, who is senior pilot of Fison-Airwork, Ltd., remarks that it is not his intention to pass judgment on any particular aircraft, and that his views are based solely on his personal experience.

TODAY, with world-wide activity in agricultural control by air ever increasing, it is not surprising to find a wide variety of aircraft in use, and equally diversified opinions on the most economical type of machine to use, and where. In the past all aircraft engaged in this work were straightforward adaptations of existing machines with slight modifications, but now a number of machines are available specifically developed for agricultural rôles.

To determine the feasibility of any proposed aerial application to crops, it is important first to be conversant with the sorts of operation that can best be performed by air, evaluate whether the expense justifies the end, and then select the proper aircraft for the particular job. The forms of agricultural work most suited to aircraft fall into four categories:—

Crop-spraying	Fertilizing (top dressing)
Crop-dusting	Seeding

Normally the decision resolves itself into choosing between aeroplanes and helicopters. It may be stated forthwith that helicopters are more costly and, where the advantage of a helicopter over an aeroplane is only marginal, economy is likely to be the determining consideration. But the common factor which is apt to be overlooked when it comes to a choice is that crop and pest control begin and end on the ground. As soon as expert intervention is called for, close liaison between the grower and the operator is all-important at every stage. In such terms a helicopter can be thought of as just another field machine requiring little additional organization to fit into any working scheme. The primary consideration is terrain. Application cost to the grower is much the same whether the crop be turnips or tamales, though it will vary with acreage, distance between areas to be treated, numbers of treatments in any given period and, to some extent with prevailing weather conditions. Terrain varies enormously. In the Sudan, for instance, where there may be one wide and open expanse of 200,000 acres of cotton, free from serious obstructions, the obvious choice is the aeroplane, and a medium sized one at that. In the Caribbean and Central American States there are equally wide expanses of closely planted, low-growing banana trees which cannot properly be dealt with even by a small fixed-wing aircraft, owing to obstructions—power lines, tall coconut palms and the like. Despite the immense acreages under cultivation the helicopter is the only answer.

There are special problems anywhere in the world, and the United Kingdom is no exception. In this country crops treated from the air are, for the most part, potatoes and seed crops. These are usually grown in larger areas than others, and are very prone to damage by ground spraying; this also applies to sugar beet. Other plants—beans, celery, carrots, etc., and occasionally fruit trees—are treated to a lesser degree. In the counties of Lincolnshire, Norfolk and thereabouts some 40,000 acres of potatoes are sprayed from the air against blight between the months of July and September. If action were not taken at the first sign of blight during this critical period thousands of acres would be rendered worthless. The treatment has to be immediate and thorough. Often the ground is too wet for land machines, or the plants are sufficiently advanced to suffer considerable damage; here the aircraft provides the ideal means.

A Government-grower scheme was in force for some years in the large potato fields in the Romney Marsh area as a prevention against the Colorado Beetle. Aerial application of D.D.T. from helicopters was found so successful that for the past few seasons no beetle has been seen and the spraying has been discontinued. As a point of interest many farmers in this area preferred a certain amount of blight killer to be mixed with the D.D.T. as a preventive against possible infection.

The aircraft shown in the heading pictures are an Auster J5G and a Hiller 360; both are operated by Fison-Airwork, Ltd.

The main pest among healthy seed-crops is weeds. Wheat, barley, oats and rye are easily stunted if weeds are not brought under control, as are peas and beans. When the crop is very young, ground spraying is practicable and effective, but slow. When the crop is a quarter grown and fresh weeds spring up, ground spraying becomes unsuitable and increasingly injurious as the crop reaches a height of one foot or more. It is not difficult to visualize the damage that tractors and other forms of ground equipment may inflict in a field of young wheat.

Bearing in mind the constantly varying types of agricultural landscape in the British Isles, the many small acreages that nevertheless may harbour pests, air coverage is by no means the be-all and end-all. If it is resorted to it has to be thorough, and to this end the advantages and disadvantages of aeroplane and helicopter may be simply set out:—

(a) The aeroplane is cheaper.

(b) Relatively larger loads can be carried which is of importance when heavy application rates are called for, as in fertilizing.

(c) The work can be done more quickly, provided that plots are large enough and free from undue obstructions.

As against these obvious advantages, there are the following disadvantages:—

(a) Few growers in the U.K. have large plots only. Therefore, once a crop has to be treated from the air, separate provision must be made for small or awkward pieces of ground. Expense is rapidly increased in comparison to normal charges where the layout is straightforward.

(b) Accidents caused by obstructions are less easy to avoid, and are likely to have serious results. It has to be remembered that about five feet from the ground is the desirable effective height of application.

(c) It is often impracticable to position landing-sites close to a crop; thus ferrying time is introduced, which is uneconomical for the operator and time-consuming for the grower.

(d) Accurate control of chemicals, due to wind drift, is more difficult. This may be vital in cases where damage would be done to adjoining crops.

With regard to the helicopter the outstanding objection is cost; it possesses no inherent disadvantages in operation. It is particularly suited to conditions in this country and has been used to the complete satisfaction of growers for many years. It does the job thoroughly at 8 per cent to 15 per cent above average ground-control costs, and there are no imponderables, as there may well be with the aeroplane when flying problems render coverage incomplete. Its main advantages are as follows:—

(a) It is able to deal with crops in large or small plots. Even in cases of apparent inaccessibility it can hover and "bomb" a very small area by means of the rotor downwash. [*Contd. overleaf*

CROP CONTROL . . .

(b) As it can fly at accurate heights and with a from-zero range of speed, the control of chemical application is exact. It can fly into corners and pause to reconnoitre before a tricky operation. Without detailed coverage, armies of tiny survivors may be left to emerge from the corners and reinfest the area after the first rain has washed the insecticide away.

(c) Ability to land anywhere makes a working liaison with the ground organization an easy matter, and supervision by the grower (if needed) is much simplified.

(d) In general, downwash from the helicopter rotor has the effect of "massaging" the spray or dust in amongst the leaves, whereas an aeroplane can provide only a surface layer. This is of enormous advantage where pests shelter and evade the surface application, as experience has abundantly proved.

(e) Finally, being based on the site, the helicopter can take advantage of every favourable opportunity at short notice (this may be set off against its generally slower methods in comparison with the aeroplane).

From the pilot's point of view the helicopter generally is more tedious and fatiguing to fly. Aerial spraying, however, and particularly when carried out at near-zero heights and where obstacles present a constant hazard, reverses this premise completely. A day spent with a helicopter is placid in comparison with fixed-wing operations, where constant vigilance, near-limit take-offs and the knowledge that engine failure may present drastic results imposes a very considerable strain indeed.

Summing up, it would thus appear at first sight that for crop control the helicopter is superior to the aeroplane in almost every respect; but this is far from being the case. It is only when the crop is sufficiently inaccessible as to render aeroplane coverage inadequate or cause it to be dangerous that the helicopter demonstrates its remarkable efficiency. Because such conditions prevail throughout most of the British Isles, fixed-wing operations are usually unsatisfactory and uneconomical.

Elsewhere in the world the aeroplane has become almost indispensable in the field of agriculture. At present some 10,000 aircraft are thus occupied, and in every continent. In a number of instances even larger aircraft are required than those available; locust control, for instance, demands an aeroplane with considerable range and capable of carrying sufficient a load to destroy swarms sometimes up to 20 miles in length.

Application rates encountered in top-dressing run up to hundreds of pounds of fertilizer being dumped within a matter of seconds, thus calling for aircraft with very large payloads. Imagine for a moment the need arising to treat grain in the vast prairies of Canada. For such a project one would certainly not think in terms of a helicopter, or even an aeroplane smaller than a DC-3! The aeroplane will always play the larger rôle in agriculture, simply because it is suited to the larger areas and consequently is in greater numbers. There will always be that other portion of the work, however, that only the helicopter can do properly. Both are certainly here to stay.

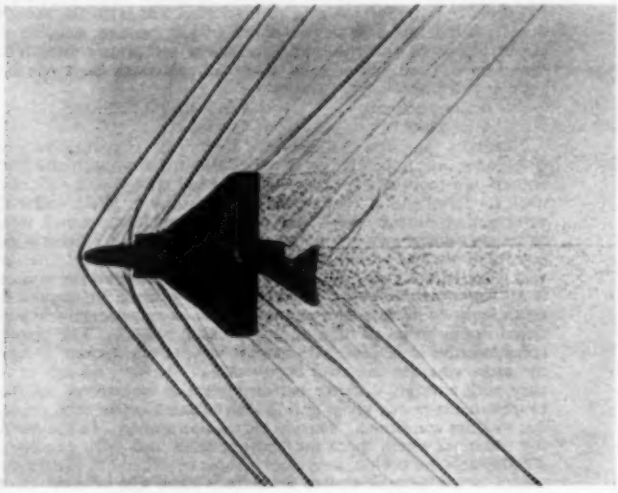
TWO-AND-SIXPENNY SUPERSONICS

THOUGH the accompanying picture appears to show a wind-tunnel model of a Javelin, its subject is literally a toy aeroplane. The photograph was taken at the aeroballistics range of the Canadian Armament Research and Development Establishment at Valcartier, Quebec, where investigations are made into the aerodynamic behaviour of aircraft as well as of shells and missiles.

A member of the R.C.A.F. in England saw a 4in-long model of a Javelin—price 2s 6d—made by Meccano, Ltd. Finding that it was aerodynamically accurate, and that even its c.g. happened to be correctly placed, he initiated a train of action which resulted in a number of similar models being sent to Canada, where the R.C.A.F. is evaluating the Javelin. At Valcartier they were used in high-speed-flow investigations, the speed being obtained not by means of a wind tunnel but by firing the model from a gun of 3.125in bore—actually a 17-pounder anti-tank gun with the rifling removed. The undercarriage was filed off and the model inserted in a sabot. (This device, a protective shoe which falls away from the projectile on leaving the muzzle of the gun, is commonly used in ballistics research.)

The Canadian news-story from which the above details are extracted concludes with the statement that "the tests showed that the model airplane is a good, stable aircraft and it flew well all along the range at its supersonic speed—the first model ever to have done so. In fact, the report confirms that the model behaved in much the same efficient way as a real airplane expressly designed for supersonic flight."

Technically minded readers may like to calculate the Reynolds number; the free-stream is atmospheric air.



The toy at Mach 1·25—with shock-pattern and wake.

TI EXTRUDED COLD

IT is reported by the Battelle Memorial Institute of Columbus, Ohio, that a research programme sponsored by the U.S.A.F. Air Materiel Command manufacturing methods branch has led to the successful cold extrusion of titanium. Starting with slugs of 1.5in diameter (commercially pure), backward cold extrusion produced cups with wall-thicknesses down to 0.22in. In forward-extrusion studies, cup-shaped billets of the same outside diameter and with a wall-thickness of 0.3125in were cold-extruded down to a wall-thickness of 0.15in with a surface finish from 30 to 60 micro-inches. The process is claimed to increase the u.t.s. by some 30 per cent.

METALS COMPENDIUM

AN extensive section of the recently published *Metal Industry Handbook and Directory 1958* has been devoted to summaries of British Standard aircraft material, D.T.D. and Admiralty specifications; and as a whole the volume provides a comprehensive and accessible source of information for all those engaged in or connected with the non-ferrous metal industries. This is the 47th year of publication and a complimentary copy is issued to each subscriber to the weekly journal *Metal Industry* (annual subscription rate £3 7s 6d; overseas, £3 12s). Others may obtain the combined handbook and directory from the publishers, Iliffe and Sons, Ltd., Dorset House, Stamford Street, London, S.E.1, at 15s net (or by post 16s 6d).

FORTHCOMING EVENTS

April 28-May 2. Institute of Metals: Golden Jubilee Meeting.
May 3. British Interplanetary Society: a.g.m.
May 4. Tiger Club: Aerobatic Competition, Sywell.
May 5. R.Ae.S.: Graduates' and Students' Section: "Future Trends in Naval Air Operations," by Capt. O. M. Bailey.
May 7. Kronfeld Club: "Flying in New Zealand," by Keith Wakeman.
May 7-17. Mechanical Handling Exhibition, Earls Court, London.
May 9. Helicopter Association: "Canadian Research in the Field of Helicopter Icing," by J. R. Stallabrass.
May 9-11. Channel Islands Aero Club: International Air Rally, Jersey Airport.
May 14. Kronfeld Club: "1958 World Gliding Championships," by Ann Welch.
May 15. R.Ae.S.: 46th Wilbur Wright Memorial Lecture: "Automatic Flight," by G. W. H. Gardner.
May 16. Institute of Navigation: "Principles of Inertial Navigation Systems" by E. W. Anderson.
May 21. Kronfeld Club: Debate, "The Golden Age of Gliding has now Passed."
May 24-26. Belgian Aero Club: Brussels Exhibition Rally.
May 24-26. Fréjus-St. Raphaël Aero Club: Provence Wines Rally.
May 25-26. S.M.A.E.: British National Model Championships, R.A.F. Station Waterbeach.
Sept. 1-7. S.B.A.C. Display and Exhibition, Farnborough.

R.Ae.S. Branch Fixtures (to May 21):—
May 1, *Glasgow*, "Small Gas Turbines," by P. J. Johnson. May 6, *Luton*, "Analogue and Digital Computers." May 8, *Cambridge*, "Aircraft Accidents," by E. L. Ripley. May 12, *Halton*, "The Domain of the Helicopter," by Raoul Hafner. May 14, *Chester*, a.g.m. and film show. May 16, *Birmingham*, a.g.m. May 21, *Hatfield*, a.g.m.

AIRCRAFT *versus* SUBMARINE

"Flight" photograph

2 : The Westland Whirlwind Helicopters of the Royal Navy

WITHIN a few miles of R.A.F. Station Ballykelly, home of the veteran long-range Shackletons whose anti-submarine work was described in these pages last week, the Royal Navy is developing a new aspect of anti-submarine operations. The place is R.N.A.S. Eglinton, the general development is the swing to helicopters, and the particular unit concerned is No. 820 Squadron, commanded by Lt-Cdr. F. W. Wilcox, R.N.

Just over twelve months ago, when *Flight* visited the majority of Fleet Air Arm units in connection with its special Naval Aviation issue, Eglinton was the home of 820 Squadron, at that time operating Gannets; while the Navy's only operational helicopter squadron, No. 845, was embarked in *Albion* and was busy with anti-submarine exercises in the Mediterranean. The much-travelled 845 was in fact the pioneer of naval anti-submarine operations by helicopter. This squadron was equipped first with M.D.A.P. Sikorsky S.55s; then (at the time of our visit last year) with a mixture of S.55s and early marks of Westland-built Whirlwinds; and finally with Whirlwind HAS. 7s.

Between March and October last year, intensive flying trials of Whirlwind 7s were carried out by a helicopter flight of 700 Squadron, commanded by Lt-Cdr. J. S. Sproule and based first at Yeovil and then at Lee-on-Solent. This unit logged a total of 750 flying hours.

The original 820 Squadron was formed in 1933 from No. 450 Flight of the R.A.F. Equipped first with Fairey IIIF aircraft, and in 1934 with Fairey Seals, the squadron included anti-submarine duties in its operational rôle. Until 1937 the squadron was attached to H.M.S. *Courageous*, re-equipping with Blackburn Sharks at Aboukir in 1936. At this time the squadron personnel comprised a mixture of R.A.F. maintenance crews; Naval, Marine and R.A.F. pilots; and Naval observers and telegraphists.

In 1937 aircraft of 820 Squadron took part in the fly-past on the occasion of the coronation of King George VI, and in the autumn of that year re-equipped with Swordfish. In November 1938 the squadron transferred to H.M.S. *Ark Royal* for what proved to be a three-year association.

The last months of 1939 and early 1940 were devoted to anti-submarine and shipping searches in the Atlantic, and April to June 1940 were occupied in carrying out attacks on aerodromes and railways in Norway. July found the squadron at Gibraltar taking part in operations against the French fleet, in the course of which the battleships *Strasbourg* and *Dunkerque* were hit by torpedoes.

In early 1941 the squadron operated in the Mediterranean, and during March and April its aircraft were occupied on convoy protection in mid-Atlantic. The greater part of May and June were spent escorting Malta convoys, but in the last days of May 820 Squadron joined the search for and the attack on *Bismarck*.

After transferring to H.M.S. *Victorious* in June 1941, the squadron rearmed with Albacores and later joined *Formidable*. From this ship 820 operated in support of the Madagascar Expeditionary Force and later in support of the allied landings in North Africa. The first half of 1943 was spent in the Western Mediterranean and support was given to the Salerno and Sicily landings before *Formidable* rejoined the Home Fleet.

In January 1944 the Albacores were exchanged for Barracudas and, after working-up, the squadron embarked in H.M.S. *Indefatigable* in June. During July, August and September

PRINCIPLES OF SUBMARINE DETECTION

A BRIEF general review of the methods of detecting and attacking submarines may serve as a useful link between the first and second parts of this article. Apart from equipment which may not be specified at present, the main means of detection are search radar, active and passive sonics equipment, and magnetic detectors. Each type is best suited to particular ranges and conditions.

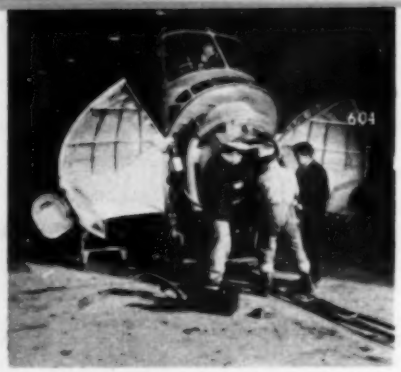
Search radar, as carried in the Shackletons whose work was described last week, is an important method of long-range detection, but its effectiveness is reduced when the submarine is submerged. For locating underwater submarines whose engines are running, passive sonics equipment, e.g., sonobuoys, are effective; while active sonar (U.S.) or asdic (British) gear and magnetic detectors—essentially a magnetometer registering the nearness of the metallic vessel—can be used against all submarines whether moving or silent.

The detection equipment used by the Royal Navy's helicopters is an airborne version of the asdic gear as used by surface ships. A concise account of the way in which sonar works was given recently in the *General Electric Review* in an article tracing the development of the acoustic homing torpedo. This stated :—

"Both sonar and an acoustic torpedo work in essentially the same manner: a short burst of supersonic sound (a 'ping' about 0.1 second in duration and 25 kc/s in frequency for sonar) is transmitted into the water. Immediately the system switches to receiving, and the transducer acts as a microphone (or hydrophone, to be exact) to pick up any supersonic signals in the water. What it wants to pick up in particular is an echo (reflection) of the outgoing signal. The information received is amplified and can be used to give visual and audio indications of the bearing and range of the object (echo-ranging) for sonar. Or it can be resolved into steering information for the torpedo. This is, of course, essentially the process by which radar operates. A torpedo that sends out its own signal, or 'ping,' and then listens for the echo is referred to as the active type."

The passive type of sonar refers to the above equipment when used solely to listen for the cavitation effect of the submarine's propellers: another example of this, as mentioned, is the sonobuoy.

Turning from detection to attack, the two main types of weapon used against submarines are depth-charges and homing torpedoes. While no details of modern British anti-submarine weapons are available, it is known that the U.S. Navy's armament has included air-launched rocket-assisted acoustic homing torpedoes for many years. A current U.S. Navy project is Subroc, or submarine-launched rocket, designed as an underwater-to-air-to-underwater weapon. Launched under water, it breaks surface and flies, using inertial guidance, and then re-enters the water; whereupon its acoustic homing system completes the guidance to target. The warhead is said to be nuclear or thermonuclear.



(Left) Senior officers of the squadron (l. to r.): Lt-Cdr. B. Matthew, A.E.O.; Lt A. A. Heasher, senior pilot; Lt-Cdr. F. W. Wilcox, commanding officer; and Lt-Cdr. F. K. Steel, senior observer. (Right) Maintenance work on the Leonides Major of one of the Whirlwinds.

AIRCRAFT *versus* SUBMARINE . . .

attacks were made on *Tirpitz*, sheltering in her Norwegian fjord.

At the end of September, Avengers replaced the Barracudas and *Indefatigable* sailed for Ceylon. The squadron remained in the Far East until the end of the war and carried out attacks on oil refineries at Palembang in Sumatra, and on targets at Sakishiwa and later on in the Tokyo area. The squadron disbanded on March 16, 1946.

At Eglinton in July 1951, 820 was reformed in the anti-submarine rôle with Firefly 5s. Following the work-up period and re-equipment at St. Merryn with Firefly 6s, the squadron embarked in *Indomitable* in January 1952. On June 15, 1953 the squadron participated in its second coronation fly-past, after which it embarked in H.M.S. *Theseus* for several months. After converting to Avenger AS.4s at Eglinton, the unit joined H.M.S. *Centaur* in July 1954 and took part in several exercises with the Mediterranean Fleet.

In March 1955, 820 re-formed with Gannet AS.1s at Eglinton, and in September of that year it embarked in H.M.S. *Bulwark* for a short period. January 1956 saw the squadron back on board *Centaur*, in which it sailed to India, Pakistan and Malaya before disbanding in May.

Gannet AS.1s were again the squadron's aircraft when it re-formed once more at Eglinton in July 1956. After working-up it operated from Ford and from *Bulwark* before disbanding in December of last year.

Transferring to helicopters while retaining the anti-submarine rôle, 820 was commissioned at Eglinton as the Navy's second operational helicopter squadron on January 21, 1958 with Whirlwind HAS.7s. The new squadron lost no time in dealing with serious matters: within weeks, plans were afoot to paint windmills as squadron badges on the aircraft, in return for the squadron's adoption of (or by) the Windmill Theatre, London.

This we were told within half an hour of our arrival at the squadron a few weeks ago. But first, we suggested, we should learn about the helicopter's rôle in anti-submarine warfare. What could the helicopter do that the Gannet could not, and how was it done?

The main advantage which a helicopter has over a Gannet—or a Shackleton or any other fixed-wing aircraft for that matter—is that it can lower its own asdic transducer into the sea, transmit its "ping" and receive an echo from any underwater object in the vicinity. In other words, it has an active detector, as distinct from passive detection by sonobuoys. It scores over ship-operated asdic also in not being affected by the sounds of the ship's own passage through the water.

The aircraft with which 820 Squadron is equipped are Westland Whirlwind HAS.7 helicopters powered by an Alvis Leonides Major derated to 750 h.p. Each machine can carry either the sonar detection equipment or a homing torpedo, at an all-up weight between 7,000 and 7,800 lb. Radar-reflecting surfaces are fitted to the main undercarriage legs for improved identification of the helicopters by parent ships or shore stations.

For the detection rôle the crew normally consists of pilot, observer and underwater controller (i.e., sonar operator). The first job of each crew during a squadron's work-up is simply to learn to operate as a close-knit team, for a task of accurate detection by helicopter is not an easy one. The pilot has to hover accurately for long periods while the sonar transducer is lowered and operated; and has to fly accurate legs or "jumps" in between the hovering periods. The observer has to keep a precise plot of the helicopter's position (and that of the submarine, if located), and pass instructions for the jumps to the pilot—in short, supervise the entire tactical operation. And the underwater controller has perhaps the most unenviable job of all.

While many of the more interesting aspects of this job, as it concerns the particular American sonar equipment carried by the Naval Whirlwinds, may not be disclosed, the general principles and problems of asdic operation obviously apply. The transducer dome is lowered into the water; it is rotated until an echo is received; and this is indicated as a bearing and distance from the helicopter. In practice, the sequence is not quite so simple, for considerable skill is needed by the operator to distinguish and interpret the slight echoes hidden in the background wake of the regular "pings." Not every echo will be from the target submarine and, even when initial contact has been established, the echo may easily be lost through incorrect interpretation of the submarine's movement.

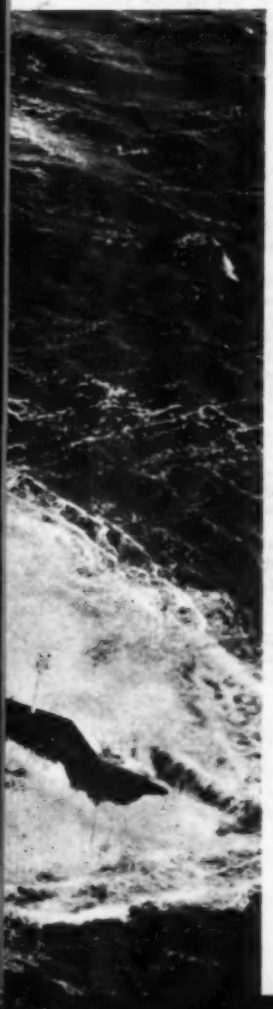
For the strike rôle a two-man Whirlwind crew of pilot and observer is adequate, while for search and rescue the sonar operator is trained in winching operations. A special lightweight manual winch has been developed for use when the Whirlwind is carrying its anti-submarine equipment; at other times, for example during search and rescue or troop-carrying operations, the Mk 7 can be fitted with the standard hydraulically-powered hoist.

The practical concept of using Naval helicopters for routine anti-submarine work on a large scale—as opposed to limited exercises—is still relatively new. There has, therefore, been no proven work-up syllabus for 820 to follow. The squadron's flying programme during the current five-month work-up period is concentrated logically on full-crew training, after an initial period of pilot training. This initial flying included general familiarization; hovering and jumping practice; continuation training, including autorotation, engine-off landings, manual flying and general flying practice; simulated and actual instrument flying; night flying; formation flying and external load carrying.

The crew-training phase began with area familiarization and navigation and search exercises, followed by asdic familiarization and training (for both observers and underwater controllers) with submarines. During these asdic operations the submarine is first limited, and then unrestricted, in its movements. The tracking of submarines by Whirlwinds operating in pairs were next on the programme, together with co-operation exercises with ships and fixed-wing aircraft. Also included is practice in the attack rôle using the homing weapon; and in winching, planeguard duties and night navigation techniques.

For many of these exercises the Magilligan range near the mouth of Lough Foyle is used as an advance refuelling base. The sea exercise areas are located between Northern Ireland and the Isle of Islay, and the use of Magilligan (ten minutes' flying time from Eglinton) as a turn-round base for the day's flights can save much time. The squadron's maintenance parties have become accustomed to spending a day in the isolation of the Magilligan sandhills, overlooked by Ben Twitch (Binevenagh), where the only other occupants are the rather boot-faced Ulster cattle whose preference for the helicopter landing area has to be firmly discouraged. Contact with civilization, i.e., Eglinton, is by a telephone link from the site's single multi-purpose hut.

Concerning tactical details of the operation of 820's Whirlwinds, the subject itself is effectively dunked in the sea of security restriction at present. It is clear, however, that these tactics are being continually evaluated, improved and refined as experience with the new techniques grows. The basic tool of dunking sonar (or dipping asdic) is undoubtedly one of the best methods in existence for detecting a submerged submarine.



A dramatic view of H.M.S. "Springer," seen just after surfacing at the end of a sonar tracking exercise off the Northern Irish coast with one of the Whirlwind HAS.7s of 820 Squadron. The same Whirlwind is pictured in the heading photograph on the previous page.

"Flight" photograph

Acting according to the highest traditions of the Service, 820 Squadron has displayed considerable initiative in anti-submarine—and other—activities. The adoption by the squadron of the Windmill girls is perhaps an example. Whirlwinds T-Tunga, Z-Zulu and V-Victor (above) are shortly to be renamed after Terry Keighley, Zoe Allen and Victoria Patterson (left to right, below).

Helicopters are ideally suited to the anti-submarine defence of the fleet. A Whirlwind cannot carry both detection equipment and the strike weapon but, having established contact by means of its sonar gear, it can call on a weapon-carrying Whirlwind, or ships or fixed-wing aircraft, to make the kill. The value of such helicopters is obviously greatly increased when they are operating in pairs; one machine can retain contact, for example, while the other jumps to a new position.

The commanding officer of 820 Squadron, Lt-Cdr. F. W. Wilcox, was previously an instructor with 705 Squadron at Lee-on-Solent. Among his senior officers are Lt-Cdr. Brian Mat hew, air engineer officer; Lt-Cdr. F. K. Steel, torpedo and anti-submarine officer and senior observer; Lt-Cdr. Richard Martin, training and analysis officer; and Lt. A. A. Hensher, senior pilot.

As a postscript to the anti-submarine activities of 820 Squadron, *Flight* can reveal that an important item of security-classified equipment is now under development at Eglinton. This is a small model windmill, of plastics construction and featuring rotating vanes, intended for small-batch production and subsequent mounting on aircrew bone-domes. The squadron's link with the Windmill Theatre is soon to be cemented further with the naming of individual aircraft after alliterative young ladies of this establishment. While the squadron's aircraft initials include X, Y and Z this is no easy task. All is well, however, thanks to Miss Xenia Scott, Miss Yvette Davies and Miss Zoe Allen. K. T. O.

WHIRLWINDS FOR AUSTRIA AND CUBA

ON Tuesday last (April 29) the first four of six Whirlwinds ordered by the Austrian Government from Westland Aircraft were due to be formally handed over to Gen. Poul Lube, C-in-C. of the Austrian Air Force, at Yeovil. They are the first British helicopters, and also the first of that size and capacity, to be ordered for the A.A.F. During the past few weeks four Austrian pilots, headed by Col. Gustav Hauck, chief helicopter pilot and instructor of the A.A.F., have been at Yeovil for Whirlwind familiarization training and were to fly the aircraft to Vienna (see photographs, page 590).

Westland also announce that two Whirlwinds have been shipped to Havana for service with the Cuban Air Force. The company's chief flying instructor, John Fay, has flown out there to test the aircraft and also to familiarize Cuban pilots in handling them.

The order follows one recently obtained by the company for Widgeons for the Brazilian Navy and is the outcome of a three months' South American tour by the Westland sales staff.

CORRESPONDENCE

The Editor of "Flight" is not necessarily in agreement with the views expressed by correspondents in these columns. The names and addresses of the writers, not for publication in detail, must in all cases accompany letters.

Racing Colours

IT was a great pleasure to read, in the letter from Mr. Graham V. Stallard, in your issue of April 18, that Southampton Corporation have put the second Supermarine S.6B, S.1596, on public exhibition.

On August 22, 1952, this aircraft was tucked away in a hangar at Southampton Airport and I had the opportunity to study it closely. Your correspondent may be interested to know that I checked the colours against the official colour-chart *Standard Shades of Nitro Dope Colourings—August 1920* and found the blue in question to be "Blue V.B.2" which is in fact ultramarine, as it was during the racing. Unless the aircraft has been redoped since 1952 it should be correct. If the colour is changed this would not be surprising—in fact, what one would quite expect.

Although the durability of the colour of dopes is usually far greater than the average life of an aircraft, change does occur and when an aircraft becomes an historic exhibit the change becomes more obvious as the years go by. Few of our historic aircraft have retained their original hue even when they have not been "touched up" with the nearest colour obtainable at the time. A very common practice is to use dopes of modern vintage on First World War aircraft. I have seen a Bristol Fighter doped "dark green" (D.T.D.83A) instead of the old "Nivo"; Camels, S.E.5As and R.E.8s have been seen in "dark earth" (D.T.D.83A) instead of the old "light earth" or P.C.10.

Verbal description without contemporary colour charts is often worse than misleading. "Dark blue" could mean ultramarine, indigo or Prussian Blue, all three of which have been used by the R.A.F. at various times.

As a matter of interest, the S.6Bs were aluminium and ultramarine (Blue V.B.2). The rudder was vermilion (V.R.3), white (V.W.3) and ultramarine (V.B.2) which was the only R.A.F. marking, as no roundels were carried at all. Black (V.BL.4) serial numbers were superimposed on the rudder stripes and outlined white. White racing numbers were painted on the fuselage sides.

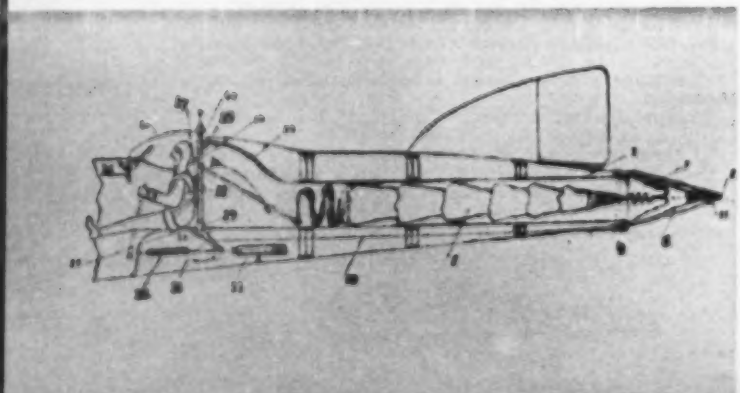
Radlett, Herts. C. RUPERT MOORE.

Ejection in 1924

RE-READING, in your May 17, 1957, issue, the very interesting article on the Convair and Lockheed ejection seats designed for the Century Series of U.S.A.F. fighters, I recollect seeing a curious drawing and reading an involved technical report addressed to the Polish Air Force Command in Warsaw some time in 1924 and signed by Dipl. Ing. Wolowski, a member of the Plage and Laskiewicz Aircraft Works in Lublin. In this report he went on to describe a new and original method of escape in "difficult conditions" from an out-of-control aircraft. I have since been able to obtain a copy photograph of the original drawing. Wolowski's design, revolutionary at the time of its appearance (1924), was in fact a prototype of today's widely used ejection seat, with the main difference that instead of being fired vertically up, the pilot's seat tilted backwards under the action of a strong spring and, with the pilot still fastened, was pulled clear out of the fuselage, through a circular tunnel (2 in photograph), by a means of primary and proper parachute assemblies (1, 6).

In an emergency the pilot operated a lever (36) in front of him, which in turn released a catch in a self-locking device at the top of his padded headrest (35, 37). The pilot's back-rest (38), to which he was fastened, was pivoted at the base (29) and tilted backwards, as indicated by the arrow, under the action of a strong spring (32), at a constant speed; this movement being achieved by the use of a vacuum damper (33). At the same time a lever (31), connected by a rod-and-hinge arrangement (9, 10) with the split-opening tail-cone, brought into operation the two half-shells of the tail-cone, thus forming an aerodynamic brake at the end of the fuselage and reducing speed. The action of this air-brake caused the release of a primary chute (6), which was intended to pull out the chute proper (1), in the folded position, with the pilot still fastened to his back-rest. When clear of the aircraft the main parachute unfolded in normal manner and further descent followed the orthodox procedure.

The ejection system described above by Mr. Orwovski.



As almost every invention is a result of necessity, so also was this ancestor of modern escape systems designed to minimize the heavy toll paid in lives by the P.A.F. flying personnel at that period (1919-1925). Here I must make a small digression and shed some light on the situation which existed in the period between the years 1919 and 1925 in the Polish Air Force, particularly in the sources of the flying equipment. At the close of World War 1 Poland was left with only 13 operational squadrons, consisting of an extreme variety of aircraft. For instance, the 4th Fighter Squadron possessed only five airworthy machines (Albatros C.III, Hannoveraner Roland CL.II, Albatros C.X, Albatros D.III and Nieuport 17). However, during the 1922-23 period, the P.A.F. command decided to unify existing flying equipment by concentrating on most popular types, and initiating the manufacture of contemporary types under licence agreements with foreign designers. It was decided that Poland's oldest aircraft factory, the Aircraft Works in Lublin, should manufacture fighters and general-purpose machines of Italian design, i.e., Balillas and Ansaldo A.300s respectively. But, as was soon proved, this choice was most unfortunate, and after completion of some 70 machines the whole production was stopped. It was found that the safety factor of the main load-carrying spar-coupling was much below the required minimum, and was the cause of numerous fatal crashes to Ansaldos in particular. In the majority of cases pilots were unable to bale-out, due to the characteristic g force in a tight spin, as the machine invariably lost one of its wings.

At this stage Wolowski's "escape method" was proposed and considered, in order to provide pilots with a higher degree of safety. There is some evidence that at least one A.300 was modified for a proposed test in Lublin, but whether this machine flew, or if the device was practically tried out, remains uncertain. That period was obscured by a somewhat blunt decision of the P.A.F. Command, who, under the influence of Gen. Leveque (at that time the French adviser to the Aeronautical Department of the Polish War Office), decided to write-off all existing Ansaldos.

Brighton, 6. J. S. ORWOVSKI.

"Prop-Jet with Jet Emphasis"

WITH reference to Mr. R. A. Harvey's explicit letter in *Flight* of February 4, here are two more lines of thought on which, as a layman, I should welcome further criticism:—

(1) To absorb unused energy in the idling turbine, might not the power be transferred to a further low-pressure compressor and/or by-pass fan?

(2) To eliminate the clutch, might one not fit a gearwheel, sliding on a simple splined shaft, which could alternatively engage the prop, or compressor, by the means of stopping each engine in turn, and feathering the blading not required?

I must admit there seems no way of offsetting the drag of a feathered airscrew, but the weight penalty of the unused blades and gear assembly in flight might be tolerated as an efficient means of thrust reversal and silencing.

Hounslow, Middx. E. B. HALL.

Wrong Gate

ON page 550 of *Flight* for April 18, you published a photograph of "A United DC-6 over the Golden Gate Bridge, San Francisco."

Never having been to 'Frisco and not having a suitable map of the area to hand, I would not know what the aircraft is actually flying "over" but I take the caption to refer to the bridge in the background of the picture.

This bridge is definitely not the Golden Gate Bridge but, in fact, the western section of the San Francisco-Oakland Bridge.

Thank you for an otherwise and usually excellent publication.

Reading, Berks. R. COATES.

Naming the New Airliners

I READ with interest the suggestions made in your March 7 issue in connection with the un-named VC.10 and D.H.121. None of the suggestions so far seem to stress the originality of the two designs. Surely a more apt name for the D.H.121 would be D.H. Trident and for the VC.10 the Vickers Velocity.

London, S.W.11. S. P. SMITH.

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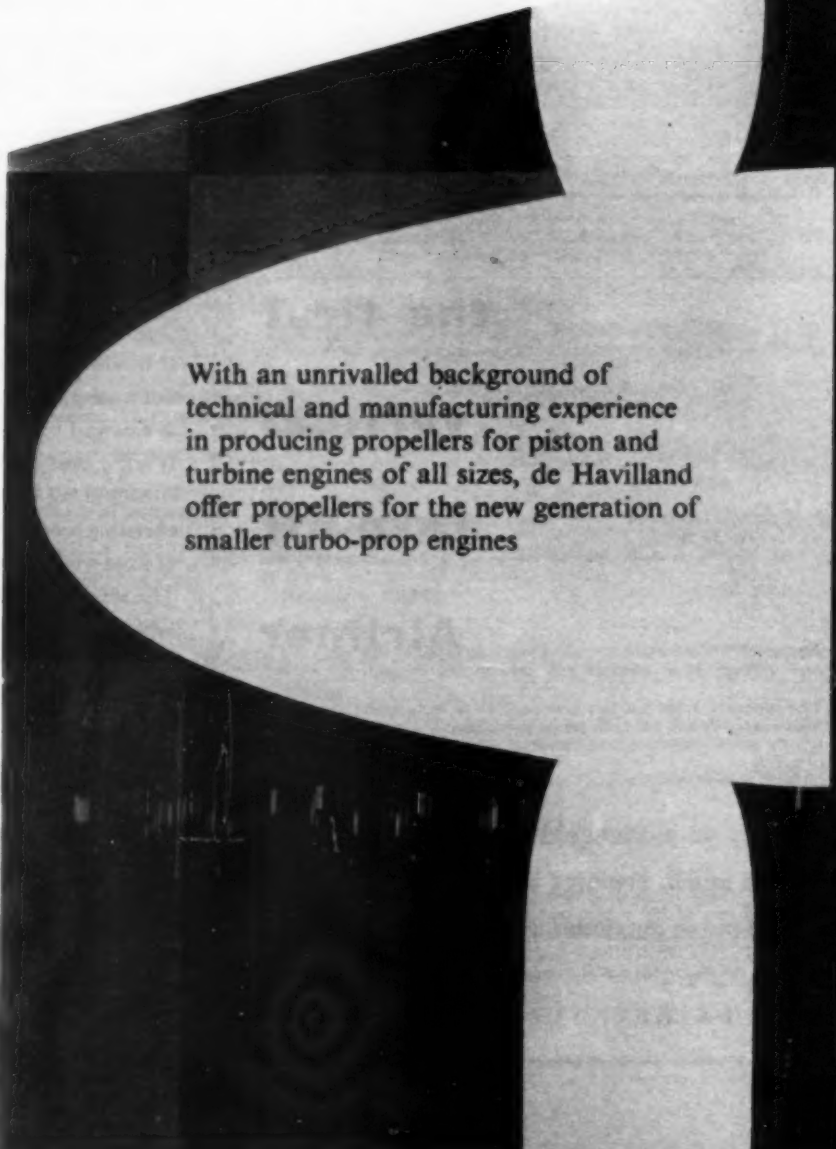

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Straight and Level

IT is fashionable to bait the American Civil Aeronautics Board. The U.S. airlines do it, I.A.T.A. does it, everybody does it—except me.

Clearly, I am out of step: but I will readily become a C.A.B.-baiter when somebody convinces me that air transport and its users suffer as a result of the C.A.B.'s actions.

Is it so wrong that there should be a government authority charged with the *economic* expansion of air transport? Some say that the C.A.B. are still living in the horse-and-buggy era. Let me throw this analogy back at them by likening the horse to the air transport industry and the buggy to the public. Without hands on the rein the whole speeding apparatus would soon be out of control, to the detriment of the buggy *and* the horse.

Of course, too much rein arrests progress: but too little—on the assumption that the horse knows best—invites an economic pile-up. The C.A.B., in my opinion, exert just the right amount of control.

We don't like planners in this country. Planner is a snarl-word. We like vaguely defined institutions like cricket and the House of Lords. The idea of a C.A.B.-equivalent to foster and promote British air transport, and to protect the interests of its users, is complacently pooh-poohed with remarks like, "Too complex for us, old boy. We don't want a lot of tame economists and lawyers messing about with our airlines."

In the meantime, we "regulate" our air transport with a Ministry which is thinking three-quarters of the time about roads, ships, railways, buses and barges; and with seven grossly overworked men on the Air Transport Advisory Council with cramping terms of reference and no executive authority at all.

Let no one forget that the economy fare was the result of C.A.B.'s lone stand against the impetuous "raise-the-fares" school in I.A.T.A. I don't expect that, when economy travel proves a big success, anyone will remember that.

● Though this weighty pronouncement by Juan T. Trippe, president of Pan American World Airways, has already been quoted in the daily Press it is well worth repeating here: "probably the most important barrier to surmount in bringing about the four billion dollar level of tourist travel is the lack of adequate hotel accommodations abroad. . . . New tourist-type hotel construction abroad since Pearl Harbor has as yet not equalled the hotel capacity bombed out or abandoned during and since World War 2. On the other hand, foreign travel as a whole has increased some 400 per cent."

More power to your arm, Mr. Trippe; and if I were a multi-millionaire I would build some hotels myself.

● Ever study the mechanical properties of pure metallic crystals? Quite a few men in the industry have heard about the almost fantastic tensile strengths of truly pure metals—laboratory results well in excess of 1,000,000 lb/sq in are now being achieved—and wish they could have such stuff in bulk. Assuming that it could be worked, and made available in all standard forms, such material could do startling things for aircraft and missile designers. I have done a few sums which show that one could make a bare DC-8 airframe (less undercarriage) weighing about 9,000 lb, compared with the current figure of about 58,000 lb.

● One of the airlines' biggest problems is how to occupy the customers. This is quite a job; how *do* you keep people happy in the confined space of an airliner cruising for hour after hour through sceneless sky?

One airline at least has found the answer, as this imposing photograph (guaranteed authentic) of satisfied customers testified. I don't know how the airline did it—but there is no doubt that it did. I just wish I understood the significance of the globe.

● For many years I have maintained that engineers are usually by no means among the beasts that perish through being unable to appreciate the arts. Several highly technical people of my acquaintance are accomplished musicians and I would go as far as to say that more engineers know more about the arts than there are artists (in the widest sense) with any clues about science or technical affairs.

The other day I thought things were going a bit too arty when I heard an American aerodynamicist talking about "having a model in B minor."

I have since learned that B-minor is the name of the 50in supersonic tunnel at the Arnold Engineering Development Center.

● A tip for senior executives who have little time to spare to prepare the lectures which they are so often called upon to deliver. Get your management information office to prepare some basic slides and illustrations; dictate and tape-record your thoughts around them; then edit the transcript.

Perhaps you have no management information office? I think you ought to have; but be careful it doesn't tend to become more executive than informative.

● I am surprised that I.A.T.A. has not had a shot at trying to establish, once and for all, the relative *potential* merits of turbojet and turboprop propulsion in air transport. I emphasize the word potential because we all know how inconclusive it is to compare actual types.

Let the airlines' leading technicians and economists throw away all the brochures, and get down to an unbiased assessment of what modern technology can achieve in optimizing each form of propulsion. Air transport is going to be built upon both forms of propulsion, so should not the airlines get down to *proving* whether or not there is a case for differential fares?

● A colleague suffers from jets at the bottom of his garden, and he is in full agreement with the distinguished engineer who foresees "mass legal action" against what I described a few weeks ago as the growing social evil of jet noise.

Reductions in decibel level of five or so, so far achieved with such ingenuity, are not enough. The public will want at least 15 decibels lopped off the noise levels of the big jets. How engine designers will do this without loss of performance is anybody's guess.

I am fairly sure that communities living near airports, and particularly those beneath the take-off and climb paths, will find that, under the common law of most countries, they will have a right of action against the appropriate Ministry (or airport owners) for unreasonable disturbance of the peace. It is fascinating to speculate upon the outcome of such an action.

● The thoughts aired above prompt the following reflection. If you had to redesign an existing straight-through jet so that its efflux was slowed down sufficiently to make its noise acceptable, would the penalties be very great? My guess is an increase in diameter of not more than 10 per cent, and an increase in weight of perhaps 20 per cent—in terms of cost in payload, say 30 passengers on a big 170-seat jet. That's quite a penalty, though certainly not so great as having your aircraft grounded by legal action.

Anyway, it is too late now. Even if jet engines were redesigned in this way the airlines would want designers to stuff in more air, and we should soon be back where we started.

ROGER BACON

DART HERALD

Handley Page's Turboprop Branchliner

IN the skies around Radlett and Woodley, Handley Page's sister aerodromes in Hertfordshire and Berkshire, a new and shapely turboprop aeroplane is becoming an increasingly frequent and welcome sight. Less than five weeks after its first flight on March 11, the prototype twin-Dart Herald had completed its first 50 airborne hours, and has already reached a stage where its handling qualities have been sampled by the A.R.B. chief pilot.

After a late start (in comparison with its competitor, the F.27 Friendship), the Dart Herald is now progressing apace, and is being flown as hard as the test programme will permit. This is an intensive schedule, and a surprisingly high return of "no snag" flights has been recorded. The aircraft should have completed its Certificate of Airworthiness trials and have received a normal category C. of A. before the end of the year, and production could be well under way by February or March 1959.

The Dart Herald is the end result of much investigation, careful design, plodding testwork and commercial thinking. It would not be unfair to say that it is also the result of some considered rethinking, because the Rolls-Royce installation is very much the result of operators' second thoughts about what they wanted, and Handley Page's efforts to meet a demand for the Dart turboprop.

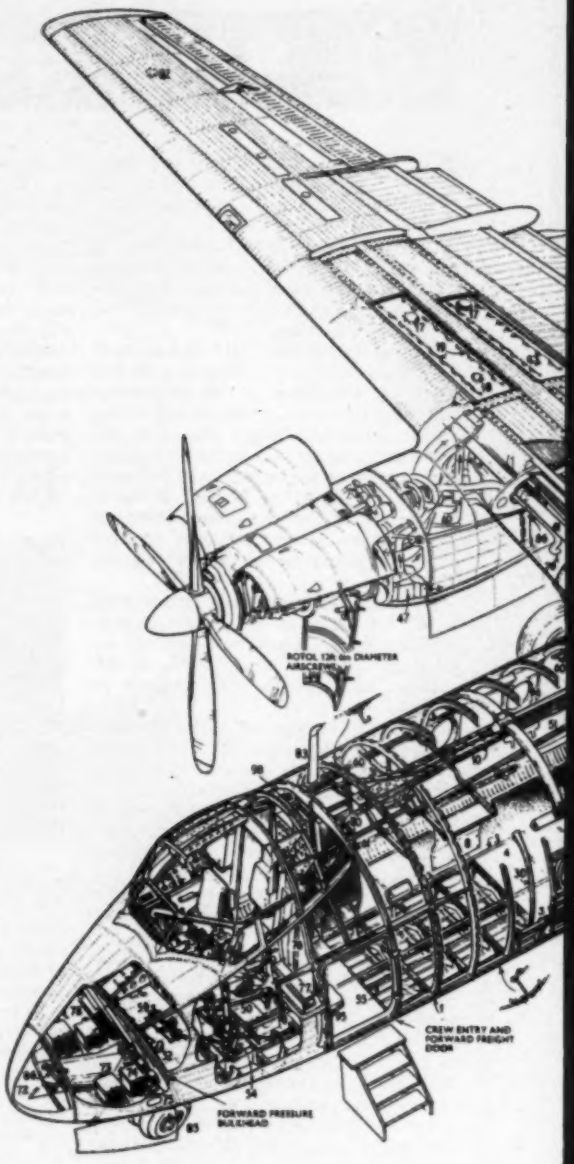
It should be made clear at the outset that the Dart Herald does not, in its makers' view, *replace* the Leonides-Major-powered Herald; it supplements it. Either engine can—more or less—be installed straight into the airframe on the common production line. In certain operating conditions, where airfields are high and the weather is hot, the Leonides Herald shows definite advantages over its faster turboprop counterpart, and it is this type of operation that the designers of the aircraft have had very much in mind.

Handley Page could not have got the Dart Herald programme under way much before they did, because they wanted to make use of the three-stage-turbine Dart to provide sufficient power for an attractive payload to be carried without detracting from other performance characteristics of the Herald. It is worth repeating that the first flight was made, right on schedule, only eight months after the engine conversion programme was started.

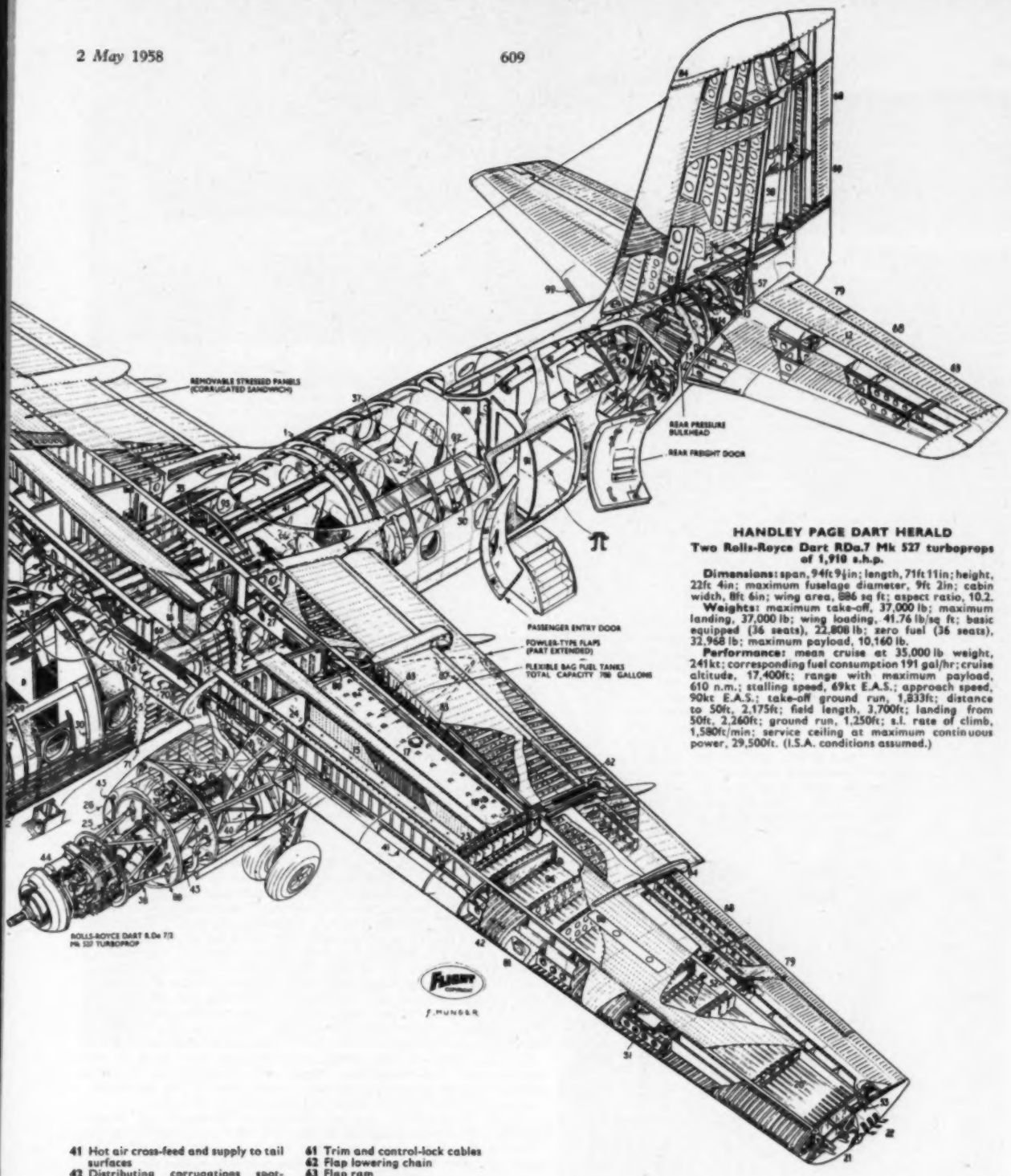
The history of the Herald to date makes an absorbing study. The cold, hard facts of the Herald story are that the bright promise of early orders for the piston-engined aircraft was plainly not fulfilled. Currency restrictions in South America and the reorganization of Queensland and A.N.A. with Ansett has made it impossible for orders for 29 Leonides Heralds earmarked by Lloyd Aero Colombiano and the two Australian airlines to stand. Handley Page are deeply committed financially and in terms of capacity to their branchliner, and they have yet to see a return on their investment. In spite of the transference of Air Kruise interest to British Aviation Services, firm orders for the turboprop version have yet to be announced.

Yet the plain facts are not the whole truth. Some sharp disappointments have had an astringent effect upon the firm and their initial discussions of the Herald are inclined to an ascetic

(Continued on page 610)



1 Transport joints
2 Top-hat-section stringers
3 Seat rails
4 Removable floor panels
5 Main wing-to-fuselage frames
6 Wing-to-fuselage pick-up
7 Notched frames
8 Hinged panels full length of roof
9 Rods carrying stringer stress through centre section
10 Main roof-rail, carrying roof flights
11 Fin attachment
12 Corrugated skin
13 Tailplane attachment
14 Centre spar (floats through fuselage)
15 Corrugated-sandwich centre web
16 Corrugated-sandwich booms with machined centre-member
17 Tank fillers
18 Fuel contents unit (dipsticks stowed on freight door)
19 Cords lacing flexible tanks to top panels
20 Z-section outer-wing stringers
21 Removable tips
22 De-icing air outlets
23 Outer wing joints
24 Undercarriage pick-up stress rib
25 Intake to heat exchanger for cabin air system
26 Intake to de-icing air heat-exchanger (40)
27 Non-return valve in duct to cabin
28 Main roof duct
29 Cabin air distribution duct
30 Air piped to floor-level duct
31 Air to cockpit and windscreen demisters
32 Cockpit air louvres
33 Mass flow control
34 Main discharge valve
35 Inwards-relief and safety valves
36 Pipe from controller in cockpit
37 Individual punkah louvres
38 Fuel heater
39 Accessory-gearbox drive
40 De-icing heat exchanger on tailpipe



HANDLEY PAGE DART HERALD

Two Rolls-Royce Dart RDa.7 Mk 527 turboprops of 1,910 s.h.p.

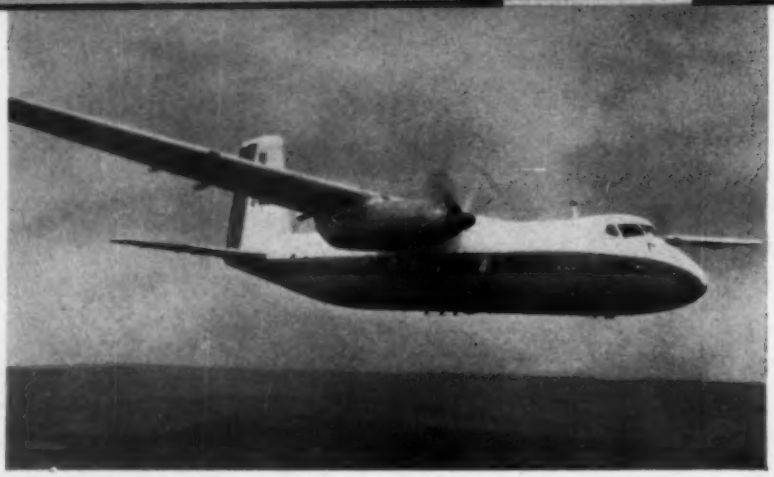
Dimensions: span, 94ft 9½in; length, 71ft 11in; height, 22ft 4in; maximum fuselage diameter, 9ft 2in; cabin width, 8ft 6in; wing area, 886 sq ft; aspect ratio, 10.2.

Weights: maximum take-off, 37,000 lb; maximum landing, 37,000 lb; wing loading, 41.76 lb/sq ft; basic equipped (36 seats), 22,808 lb; zero fuel (36 seats), 32,968 lb; maximum payload, 10,160 lb.

Performance: mean cruise at 35,000 lb weight, 241kt; corresponding fuel consumption 191 gal/hr; cruise altitude, 17,400ft; range with maximum payload, 610 n.m.; stalling speed, 69kt E.A.S.; approach speed, 90kt E.A.S.; take-off ground run, 1,833ft; distance to 50ft, 2,175ft; field length, 3,700ft; landing from 50ft, 2,260ft; ground run, 1,250ft; s.l. rate of climb, 1,580ft/min; service ceiling at maximum continuous power, 29,500ft. (I.S.A. conditions assumed.)

41 Hot air cross-feed and supply to tail surfaces
42 Distributing corrugations spot-welded to skin (all leading edges)
43 Accessories-cooling air
44 Oil cooler
45 Cabin-air silencer
46 Cabin blower
47 Cabin-air heat exchanger
48 6 kW generator
49 7½ kVA alternator
50 Aileron torque rod from column cross-shaft
51 Aileron push-pull rods
52 Aileron spring-tab torsion bar
53 Aileron mass-balance
54 Rudder and elevator levers
55 Rudder and elevator tension rods (under floor)
56 Rudder push-pull rods
57 Elevator push-pull rods
58 Rudder balance
59 Rudder pedals with toe brakes
60 Pitch and power push-pull rods
61 Trim and control-lock cables
62 Flap lowering chain
63 Flap ram
64 Flap guide-rails
65 Flap operating cables
66 Flap and undercarriage emergency-lowering air bottle
67 Starboard console, mainly electrics (port console, mainly electrics, not shown)
68 Trim tab
69 Balance tab
70 Under-wing intake to cabin air blower (lip shrouded for ice-protection)
71 Centre-section frames hinged at chine-member
72 Inverters in nose cap (not shown)
73 Accumulators
74 Relays
75 Ground supply socket
76 Main fuse panel
77 Generator circuit-breaker panel
78 Standby accumulators
79 Spring tab
80 Fuselage cable-run
81 Dual-purpose taxi/landing lamps
82 C.L.2 compass detector
83 H.F. aerial mast
84 V.H.F. suppressed aerial (aerials not visible: A.D.F. loops; A.D.F. sense; I.L.S. glide-path; I.L.S. marker; radio altimeter)
85 Steerable (110 deg) nosewheels
86 Door linkage
87 Extended (drooping) nacelle fairing (water/methanol tank, port only)
88 Firewall
89 Top pick-up, undercarriage sub-frame
90 Removable toilet
91 Removable bulkhead
92 Removable luggage racks
93 Aft escape door
94 Forward escape-hatch
95 Tip-up seat and buffet space
96 Integral tanks (160 Imp. gal each side)
97 Control lock
98 Movable radio racks
99 Inverted slots on tailplane leading-edge

DART HERALD . . .



Although the nacelle accommodates the original undercarriage a slim profile has been obtained. All future Heralds will have the new oval windows of this Dart prototype.

reappraisal. They have faced the agony of their decisions and emerged calmly confident of the technical merit of their product. There has been some searching self-examination at Handley Page, and their self-confidence has not been impaired; rather are they reaching through difficulties to maturity in the difficult and competitive commercial aircraft world of 1959 and beyond. They are prepared to re-examine their case and their arguments in a completely straightforward fashion, and this account is written not without admiration for the boldness with which these issues are faced.

There is plenty of very close interest in the Herald. Apart from that of B.A.S., if Australia's policy of Imperial preference is carried through it may influence the sales of the Herald. Trans-Australia Airlines are committed to Friendships, but there is apparently plenty of interest in the Herald in Australia. Senator Paltridge, the Minister of Civil Aviation, and Mr. Donald Anderson, the Australian Director-General of Civil Aviation, were impressed with the aircraft during their recent visit. New Zealand's air routes, with a longest stage-length of 250 miles, could well be Herald country. There are possibilities in India and in South America.

Only in the United States has the Friendship challenge so far been given undisputed sway; Dutch business acumen which led to manufacturing agreements with Fairchild, has made the U.S.A. a tough market to crack open, although the Dart Herald will, incidentally, meet all C.A.A. strength and performance requirements. In any case, although the Herald and Friendship are closely competitive, their spheres of influence do not entirely overlap; the slightly sleeker Friendship inclines a little more towards the more sophisticated routes; the robust, simple Herald to operations where reliability and airfield performance are at a premium.

Perhaps the biggest stumbling block in the way of more rapid Herald sales has been the sheer inability of DC-3 operators to find money for replacement fleets. Naturally enough, they are not too willing to be the first to take the plunge for what is still an untried design, and the combination of a new airframe with a promising but new piston engine with a limited initial overhaul life could not be described as a really attractive proposition. Things might well have worked out differently, particularly if the Alvis Leonides Major had received more substantial military backing. But this was not forthcoming and, in view of the popularity of the Dart, and the recent availability of the RDa.7 with sufficient power to give a twin-engined aeroplane a good payload performance, the turboprop decision was undoubtedly the right one (the Herald uses Dart Mk 527s of 1,910 s.h.p. for take-off).

Extensive testing has been done on the Herald fuselage at the Radlett structural test laboratory and 100 per cent ultimate load has been successfully reached on the critical landing and torsional cases.

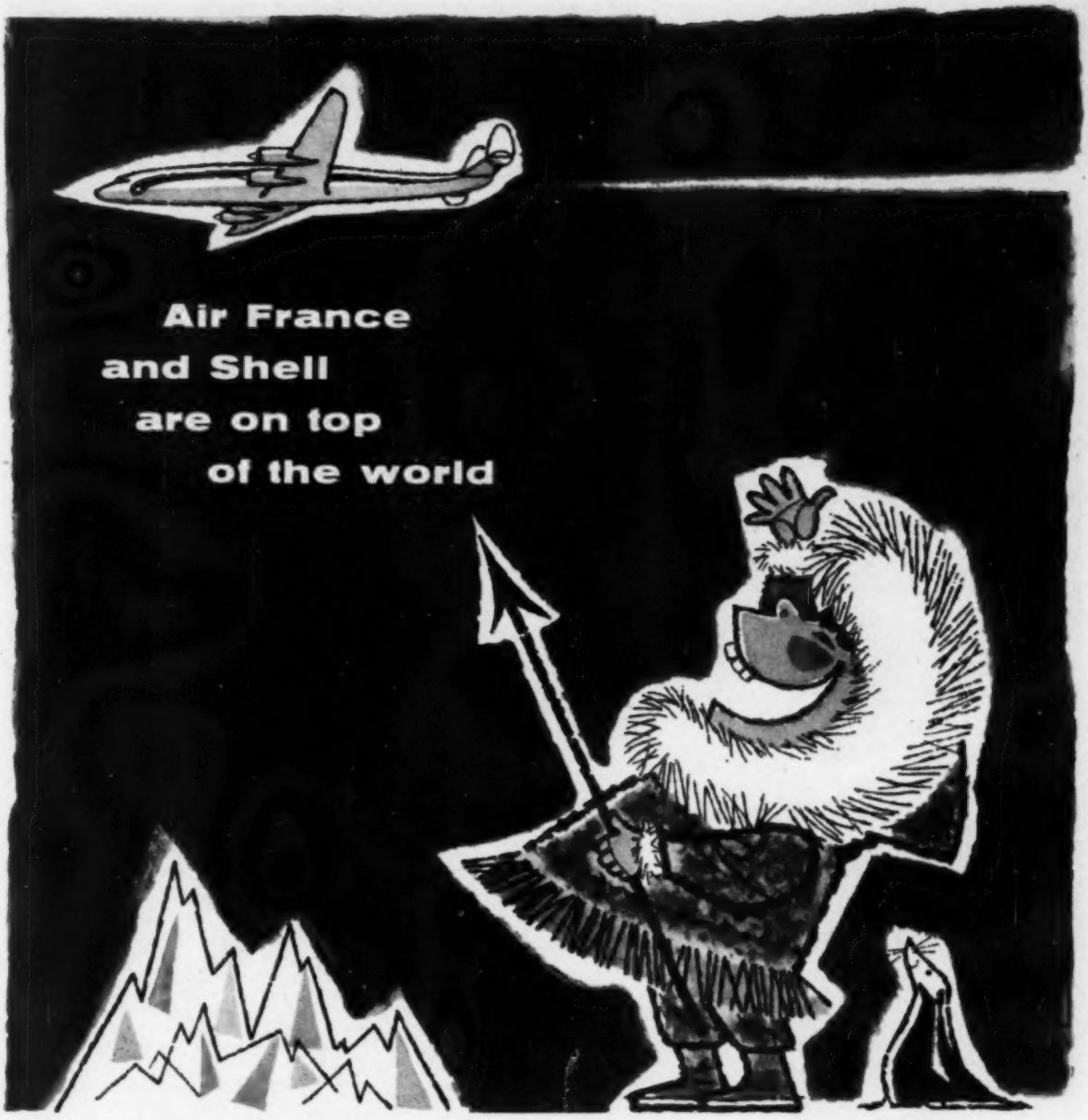
Of course, H.P. fervently wish that it were possible for a major local airline—B.E.A. for example—to assist this private venture by working the aircraft over their routes for development purposes. But the Corporation are only prepared to extend their altruism so far, and in any case their policy is to progress their Viscounts on to the remaining routes operated by DC-3s. But a very satisfactory alternative arrangement has been worked out with Derby Aviation, who are very satisfied users of the H.P.-developed Marathon. Being geographically so close to Rolls-Royce, and with H.P.-Derby Aviation liaison already well established, a practical agreement has been reached by which Derby will charter a Dart Herald (with an option to purchase) for intensive flying during their busy summer season. This should help Handley Page to acquire much-needed operating experience. It might be greatly to Derby's advantage, too, beyond helping out with extra capacity at a peak time; but it would be unfair to speculate further about possible orders when H.P. so resolutely refuse to do so themselves.

To continue this analysis in the earlier vein of appraisal, it does seem fair to ask whether, in fact, there is very much promise for the piston-engined Herald. Mr. Jack Frye's Safari was discontinued in piston-engined form, even with the well-developed Wright or Pratt and Whitney powerplants that it was intended to use. Handley Page, of course, have reached demonstration stage with two aircraft, but even these are being converted to Dart power. Most of the hopes for the aeroplane lie in the turboprop version, so what future is there for a piston-engined Herald?

Part of the answer lies in the short-field aeroplane already mentioned, and part in the concept of the Herald as a four-engined aircraft. Four Darts, even, say, four RDa.6s, would not have been a practical solution for this class of operation, encroaching as it then would on the Viscount field. But four engines hold great attractions for many operators, and the possibilities of say, four 1,000 s.h.p. turboprops have been very carefully considered. The mounting points for four engines are still incorporated in the structure of the Dart-powered Herald. The airframe is also capable of taking higher powered Darts and is structurally sufficient for the RDa.10, provided that some local stiffening were done in the nacelle and the asymmetric engine case reconsidered. Greater powers would permit appreciably greater payloads to be carried, or further improve the runway characteristics, or both.

Any impression that the Dart Herald is a "bandaged-up" design of the earlier version should be dispelled by a consideration of the structural changes that have been made for the faster aircraft. The Dart installation has been a complete redesign within the present geometry, particularly as regards the wing, which carries an additional 30 per cent bending load. The Dart Herald is in every way a carefully conceived design, with passenger, freight, and radio and radar calibration versions. In super short-haul form, it boasts the necessary adjuncts of whistle-stop operation—large loading doors, port propeller run-down brake, coincident take-off and landing weights, ample water/methanol capacity and mechanically operated built-in loading steps. The low speed handling is reported to be good and pleasant for frequent landings.

The high wing was an obvious choice for the Herald. Aerodynamically, the aircraft gains valuable pendulum stability (the Leonides Herald was noted for its smooth ride) and makes possible



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ROTOL PROPELLERS AND GEARBOXES
ARE FITTED TO ALL TYPES OF
ROLLS ROYCE DART ENGINES

DART HERALD . . .

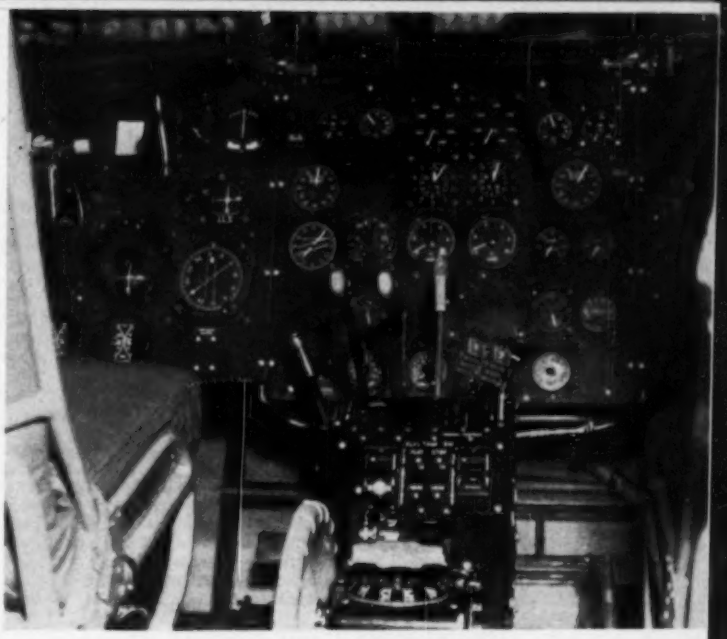
a large flap area. The low floor is ideal for quick loading and the large propellers and comfortable tip clearances are valuable for operations from short, rough airfields. Short-haul passengers tend to study their local terrain rather than settle down to reading, and the high wing and enlarged windows of later Heralds give a splendid view. It has also been suggested that it is more reassuring for passengers to look at the smooth tension skin of an aircraft's wing rather than a wrinkled upper surface.

If there is any one criterion that stands out above all others, it is that for the Herald type of operation, the structure should be absolutely sound and guaranteed for the life of the aircraft—quite a tall order for a pressurized airframe. As Handley Page point out, new spars at 20,000 or 30,000 hr are not included in cost equations, but can add very considerably to the maintenance expense over the aircraft's operating life. The airframe must also continue to give good aerodynamic performance when it has been operating hard for many years, when it is patched and dirty and even a little dented. And to suggest that old aeroplanes will maintain their new sparkle is plainly to close one's eyes to the obvious.

The Herald airframe has been extensively restressed for Dart power. The tail and 20in longer fuselage (the section has been added to adjust the centre of gravity and bring the crew door forward of the plane of the propeller discs) has been tested to 100 per cent load under torsional fin and rudder side loads at 37,000 lb gross weight and to the severe case of a propeller failing by going into flight fine pitch, which applies a severe asymmetric side load. Two loading cases have also been simulated on the fuselage and centre section: maximum shear on the centre section and a maximum bending case aft of the rear spar. A pressure test in air, with strain gauges at 3,000 different positions on the fuselage has been carried out by H.P. Stress levels at the full differential pressure of 3.35 lb/sq in are less than 8,000 lb/sq in, except at isolated concentrations where a maximum of 15,000 lb/sq in is allowed, and the Air Registration Board have allowed the fuselage an infinite fatigue life. Certification testing will be completed by pressurizing the fuselage in the water tank at Farnborough at 2P and then cycling it at 4.2 lb/sq in to determine the rate of crack propagation and the form of final failure. It remains for a tip-to-tip test to be done on the wing in the structural test department at Radlett. Premature failure is frankly not expected, and fatigue tests can consequently be simplified. Various panels and joints have been fatigue-tested and discussions are now being held with the A.R.B. on clearing the wing for infinite fatigue life. The test wing will be deliberately cut to prove its fail-safe properties by further testing in the Radlett laboratory.

The Herald's wing section is substantial. It varies from NACA 23016.5 at the root to NACA 4412 at the tip; the separation point is reasonably well forward on the chord and the wing is thus less sensitive to dirt and minor deformations than a more laminar flow section. The Alvis-engined Herald was designed as a simple single-component aircraft with easy interchangeability. The centre section spar flanges on the three spar webs were 10 s.w.g. rolled angle and acted merely as shear carriers; bending was taken by the sandwich skin and centre spar flange composed of a corrugated sheet core spot welded to the outer skin and Pop riveted to the inner one.

A major change in the Dart Herald has been the addition to the 40ft centre section of machined upper and lower centre spar flanges to react the increased bending moment introduced by the 20 per cent higher maximum speed of the turboprop version and the lack of bending moment relief with only two engines. The opportunity has also been taken of working to C.A.A. as well as A.R.B. requirements, and 10,000 lb/sq in has been set as the limit—on fatigue considerations—for a 1g stress.



Instrument panel of the prototype Dart Herald has been much simplified with the reduction in the number of engines fitted. The second prototype and production aircraft will be further improved.

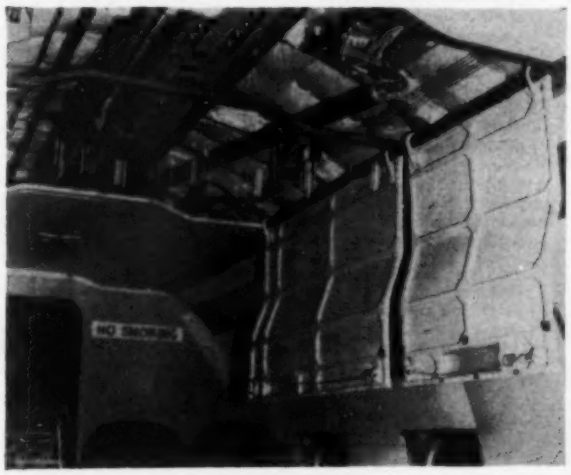
The new spar flange is an interesting example of fail safe design technique. The flanges are planks of 24 ST, a material chosen for its low crack-propagation qualities. The upper compression boom is used as-rolled, and the tension boom is machined all over and routed to the required section. Both booms are split spanwise along their complete length to avoid cracks propagating from one half of the boom into the next, so that the tension and compression booms form four separate units. The remainder of the centre section is made up of light front and rear spars, much as before, although skin gauges and sections have been stiffened throughout the wing. There are very few ribs in the centre section apart from the end ribs and undercarriage ribs, as a continuous rib is formed by stress-carrying sandwich covers attached to the centre spar flanges and to the angles on the fore and aft spars. The critical tension flange is machined so that the lower surface forms part of the wing skin and is thus always open to inspection for fatigue cracks.

This is a fail-safe structure by design and not only by demonstration. Sixty-six per cent of the ultimate load can still be carried if one half of a centre spar flange fails, or a front or rear spar and a corrugated cover, or various other combinations or isolated instances of fairly major—and unlikely—failures. Crack propagation is likely to be quite slow and incipient failure of a flange or a panel should not be difficult to spot at an early stage. This also applies to the corrugated sandwich covers; it has been H.P.'s experience that a crack is likely to be seen on the outside many hours before a complete failure can occur, and in practice they do not anticipate failure at all. Fatigue tests have demonstrated that cracks on corrugated cores will spread to the outer skin before a failure takes place, and a special and simple technique for detecting a failure of hidden components is being developed.

A novel technique employed in the centre section is the method of lining the tank bay with nylon sheet to prevent the ingress of swarf and dirt. This has a very beneficial effect upon tank life and the bay has been passed by the A.R.B. for inspection at four-year periods. Should a leak occur (the flexible Fireproof tanks are buttoned and laced into position), a drain is led to a tell-tale spill outlet on the inboard side of the engine nacelle, where it is visible from the cabin.

The outer plane has been similarly affected by the increased loadings imposed by installation of the Darts. Under Handley Page's direction, redesign and construction of the outer panels is being done by Boulton Paul at Wolverhampton. Heavier stringers, machined inboard, drawn strip outboard, have been added in way of the centre spar to diffuse the loading from the two-spar outer wing. For the Dart aeroplane, an integral tank has been incorporated in the outer plane, immediately outboard of the multi-bolted wing joint. Access holes large enough for two-handed maintenance operations have been added and these are closed by stress-carrying doors with machined stringers. Stringer joints have been redesigned throughout and most of the plating has been up-gauged. Extensive use has been made throughout the wing of corrugated sandwich skins and H.P. have developed their spot welding technique for use all over the primary structure. For such applications

Design for serviceability: the cabin roof panels drop down to expose electric cable and flying control runs. Thick looms have been avoided.



DART HERALD . . .

as the attachment of transverse corrugations to the outer skin, roller bits are used which spot weld at predetermined intervals along the channel length. The impression of the roller (which is held at a contact pressure of about 1,200 lb/sq in) is left on the outside skin and imparts an almost stitch-welded appearance.

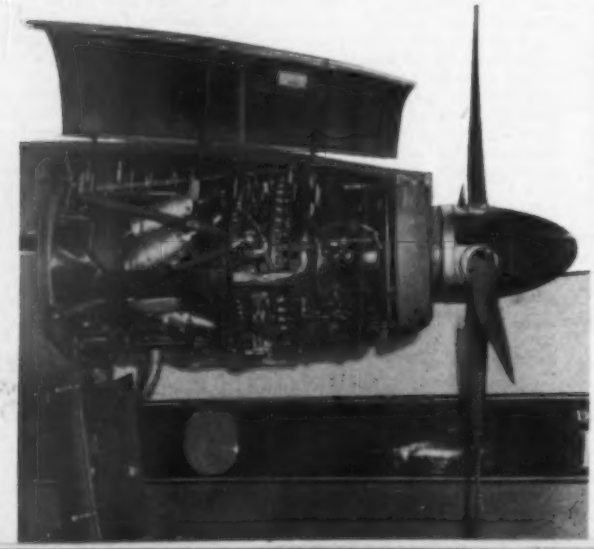
The greatest danger in a two-spar wing panel is that the strength of the torsion box will be lost through a cracked web. To guard against this and to maintain the fail safe policy throughout the wing, crack-stopping members or a third flange on the spar webs localize any crack that may occur.

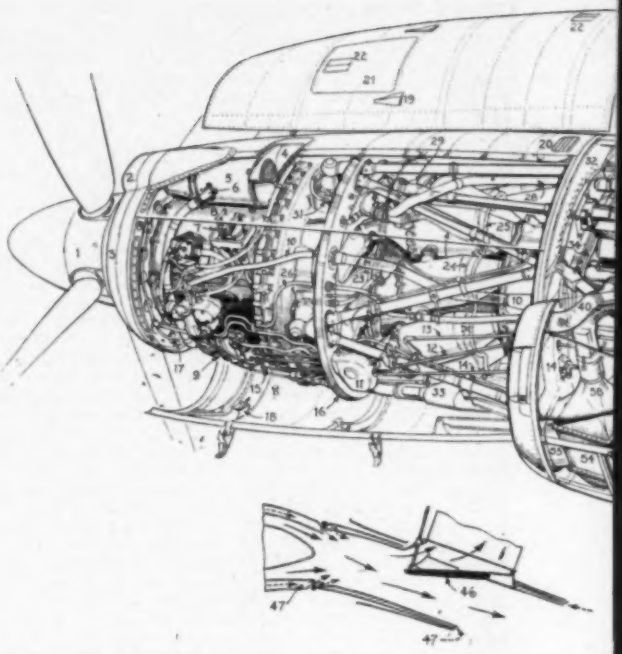
The multi-bolted wing joint replaces the earlier type of pipe joint which, although it avoided the necessity for a reaming operation in fitting a new and completely interchangeable outer wing panel, was heavier and less efficient. The tip is very simply attached by four bolts and three spigots, and the leading edge is riveted in place. Local damage should be minimized by the stiff leading edge, but a repair can be made by skinning over with a new piece of sheet if the damaged area is small (on the outer plane, where de-icing hot air is passed through shallow corrugations, this could result in a small loss in efficiency), or by replacing prepared sections of corrugated leading edge. A multiple component wing has now been achieved by intent and the safe life should be declared at about 50,000 hr.

The Dart nacelle is broad in plan but slim in elevation, and gives an impression that the powerplants are canted outwards. Handley Page have been very satisfied with the Electro-Hydraulics undercarriage—the Leonides-powered airframes flew about 400 hr and were subjected to at least one landing an hour—and very much wanted to retain it in the Dart Herald. Many nacelles were schemed before the present one was adopted, which is a very fair compromise between the ideal shape as proved by tunnel tests and a design that would allow plenty of working room and a straight jet pipe. As it is, the jet efflux is inclined at only 20 deg; an advantage that just about offsets the extra drag of the slightly larger nacelle. The same undercarriage has been retained, retracting forward and fitted with large tyres with low pressures—58 lb/sq in at full load. Goodyear anti-skid braking is used and the wheels are automatically braked during retraction and maintained lightly braked until the leg drops. The design of the nacelle is such that it has been possible to make a very attractive and logical layout of the various services, and five people can work inside it at once if necessary. The high wing and long nacelles are an advantage here, because the nacelle interior keeps very clean and mud from wet, grassy fields does not penetrate up inside to soil the service panels.

Forward of the firewall, the engine mounting is identical to that adopted by Vickers with their Viscount 810, and in an emergency a Dart 525 could be installed in the Herald—or *vice versa*, if the power ratings were adjusted. There is a substantial degree of interchangeability between the two installations, but naturally the engines will be operated differently and it may be some while before overhaul lives become the same. Viscount similarities will, however, go some way towards helping Handley Page to obtain certification.

In one important respect, the powerplant installation is quite different. Although they have not yet flown production-type propellers from Rotol, Handley Page will fit on the Herald a propeller of 12ft 6in diameter—the largest yet used in conjunction with the Dart. Unlike the Viscount 810 RDa.7 installation, a two pitch-lock propeller (see *Flight*, February 28, page 273) is not used. H.P. were anxious to save the weight and additional expense of the twin-lock mechanism and in any case the Herald's maximum speed is 30 m.p.h. under the engine bursting speed should a flight fine pitch runaway failure occur. The gear ratio used with the large propeller is 0.093 which gives a tip speed comparable to that of the Viscount.





This drawing is a view looking outboard to the starboard engine nacelle. The undercarriage is shown swung forward in the partly retracted position and the small inset sketch shows a section through the jetpipe, with a Vickers flap controlling hot air to the heat exchanger.

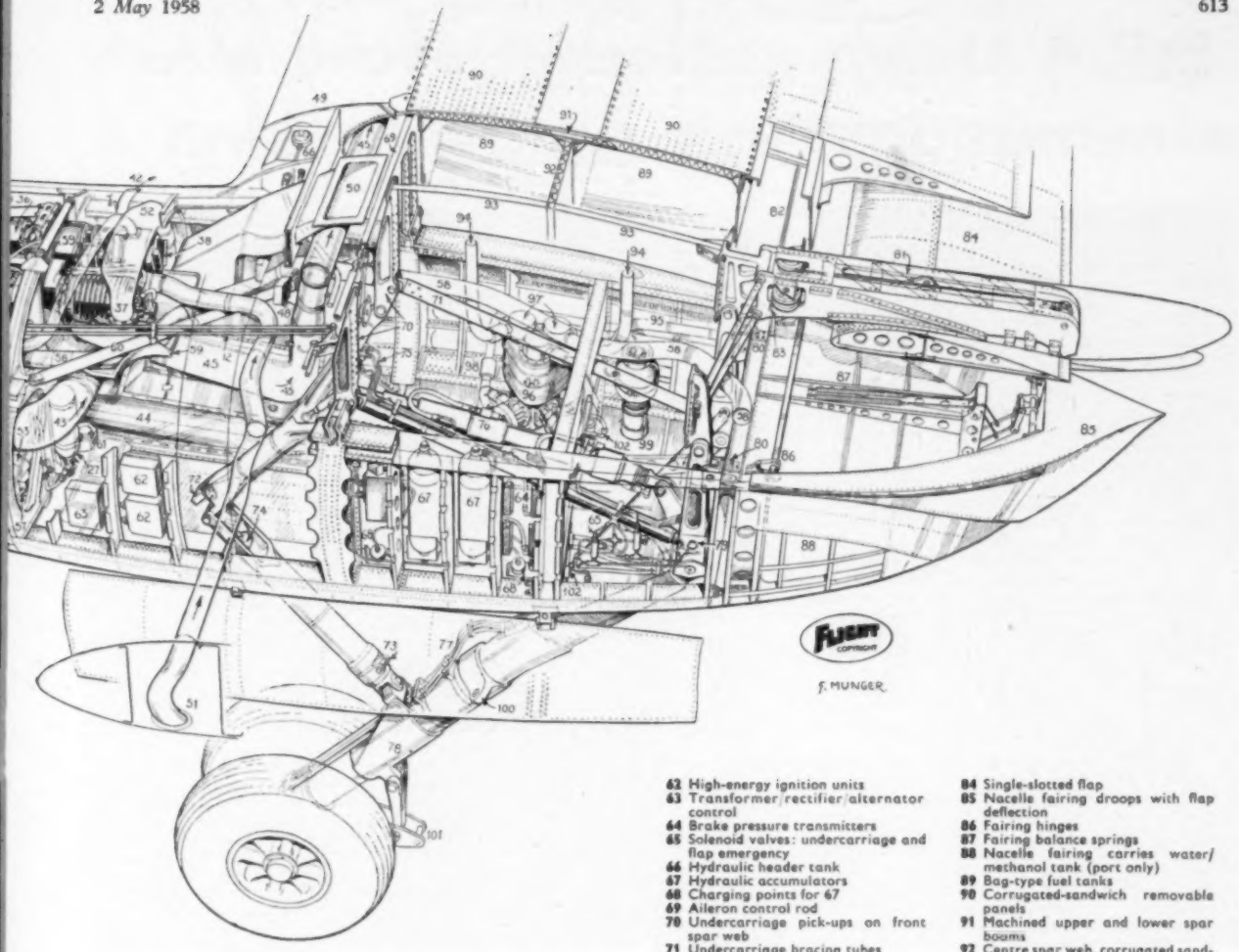
1 Rotol 12ft 6in dia propeller
2 Oil-cooler intake
3 Napier Spraymat anti-icing
4 Oil-cooler air outlet
5 Oil cooler
6 Scavenge oil to cooler
7 Oil-tank filler
8 Dipstick
9 Fuel-control unit
10 Water/methanol delivery pipe
11 Control integrating box
12 Throttle rod
13 Pitch
14 Trim
15 Shut-off cock
16 Zone 1 firewall
17 Zone 1 spray-ring
18 Zone 1 cooling air
19 Zone 2 cooling air
20 Hot-air outlet (engine shut-down)
21 Pressure-relief door
22 Fire doors
23 Zone 2 spray-ring
24 Graviner Firewire
25 Firewire support ring
26 Methyl bromide delivery
27 Methyl bromide bottle (12 lb)
28 Engine breather
29 Accessory power take-off
30 Accessory box drive-shaft
31 Fuel manifold
32 Zone 2 firewall
33 Fuel heater
34 Stressed shear-panel (top and bottom)
35 6kW generator
36 Hydraulic pump
37 Godfrey cabin blower
38 7½kVA alternator
39 Tachometer generator
40 Generator and alternator cooling
41 Cooling-air out
42 Alternator cooling-air out
43 Ram air to anti-icing heat exchanger on jetpipe
44 Jetpipe
45 Hot anti-icing air from heat exchanger
46 Vickers flap: exhaust gas deflector
47 Jetpipe cooling air

The cowlings are of Handley Page design. They have a fortuitous similarity to those of the Friendship, the probable result of a common solution to high-wing aeroplane cowling problems. The bonnet-type of cowling is lighter than a full petal arrangement, and it is not necessary to move the ladder away in order to open the side panels. The bonnet can be removed by undoing four bolts.

Very few changes have been made to the Herald fuselage, apart from the slight increase in length. The new windows (common to both versions) are of simple form and the inner glazing is less domed than hitherto. It carries a reserve factor of seven, and if it fails the outer window is capable of taking pressure loads. The structure as a whole is stressed to $3P_W$. In spite of an increase in structure weight of about 500-600 lb for the turboprop Herald, the structure remains a very efficient one and gains from a comparison with the Friendship.

A simpler cockpit has been made possible by the reduction in the number of engines, and the company have rearranged the switches on the roof panels and side consoles so that the work is shared more evenly by the two pilots. Their philosophy is that "we do not believe that we can please everyone with our cockpit, but we have incorporated the best features suggested by dozens

Forward of the firewall the Herald Dart RDa.7 installation is similar to that of the Viscount 810. The cowlings are of Handley Page design; the side panels can be quickly removed if necessary.



48 Anti-icing air control actuator
49 Corrugated leading-edge thermal anti-icing
50 Exit duct for exhaust gas deflected through anti-icing air heat exchanger
51 Shrouded under-wing intake to cabin blower
52 Blower delivery to 54 via transverse silencer and spill valve
53 Silencer
54 Cabin-air heat exchanger
55 Cabin-air heat-exchanger intake
56 Cabin-air heat exchanger air outlet control flap
57 Actuator for 56
58 Cabin air delivery
59 Accessory-box drip tray (corner relief for wheel)
60 Nacelle cross-brace tube
61 Differential-pressure switch: fuel filter de-icing
62 High-energy ignition units
63 Transformer/rectifier/alternator control
64 Brake pressure transmitters
65 Solenoid valves: undercarriage and flap emergency
66 Hydraulic header tank
67 Hydraulic accumulators
68 Charging points for 67
69 Aileron control rod
70 Undercarriage pick-ups on front spar web
71 Undercarriage bracing tubes
72 Down-lock latch
73 Up-lock catch-pin
74 Down-lock micro-switch
75 Supply lines and swivel-union blocks to lock-jack
76 Undercarriage main jack
77 Hydraulic lines to Goodyear disc brakes (anti-skid units optional)
78 Electro-Hydraulics main leg (partly retracted)
79 Main leg links to rear spar pick-ups
80 Nacelle rear mountings
81 Flap guide-rail
82 Flap operating cables from ram
83 Flap cross-connecting cable
84 Single-slotted flap
85 Nacelle fairing droops with flap deflection
86 Fairing hinges
87 Fairing balance springs
88 Nacelle fairing carries water/methanol tank (port only)
89 Bag-type fuel tanks
90 Corrugated-sandwich removable panels
91 Machined upper and lower spar booms
92 Centre spar web, corrugated sandwich
93 Undercarriage stress-bearing ribs
94 Fuel from bag-tank to collector tank
95 Fuel from outer wing integral tank to collector tank
96 Collector tank (two booster pumps)
97 Fuel level valves
98 Cross-feed pipe
99 Integral emergency hydraulic power packs
100 Picketing point
101 Towing point
102 Door jacks

of visiting pilots over the past two years." The I.F.A.L.P.A. "basic T" panel layout has been adopted and Thorn red pillar lighting for the instruments.

The engine control layout includes a flight fine pitch withdrawal lever (Vickers changed from an undercarriage-operated micro-switch to this arrangement on the V.810) and gust locks which prevent more than one engine from being opened at a time when the aircraft is on the ground.

Some of the control-surface development work that was done on the Leonides Herald has of necessity to be repeated for the Dart aircraft. A detail change has been the addition of cable tensioners to the mainly tie-rod control system. A combined spring and trim tab is fitted to the rudder and individual spring, trim and geared tabs to the elevator. For some time past the tailplane has been fitted with a small inverted slot at the leading-edge root to prevent root stall of the tailplane under certain side-slip conditions—a phenomenon of most high-wing aircraft. The Herald is now capable of a 20 deg side-slip at take-off power with no change in trim.

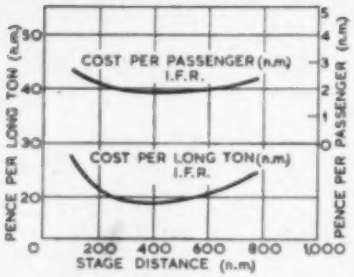
With the introduction of the Dart most of the systems have had to be reworked. The total fuel capacity is now 1,080 gal (30 gal are unusable fuel); 180 gal and 160 gal are contained in flexible tanks one behind the other in the centre section and the integral tank in the outer wing carries 200 gal. Each tank drains by gravity into a collector tank in each nacelle and three S.P.E. fuel-level valves control the flow from the three main tanks. Two booster pumps are fitted into each collector tank and so arranged that they can be withdrawn without the need for draining the fuel.

Each tank is filled individually from above the wing, but under-wing pressure refuelling could be provided if an operator required it. Water/methanol is contained in a single 53 gal tank in the port nacelle, with a cross-feed to the starboard engine. There is sufficient capacity for two take-offs under high-temperature conditions; and, if a starboard tank were added, the number of take-offs could be increased to five or six without replenishing with water/methanol. A cross-feed is essential in the engine-cut case, because although the dead engine requires no injection the fluid requirement of the other may be correspondingly higher.

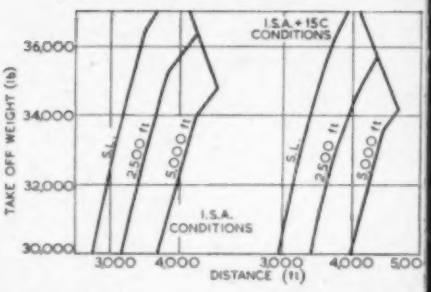
Hydraulic power is now supplied by a pump driven by each engine accessory gearbox, but the emergency supply has been changed from 3,500 lb/sq in air storage bottles (which in some countries are not permissible) to an Integral electrical pump unit with its own reservoir. The only common pipes are in the under-carriage and flap jacks themselves.

Electrical power is supplied by two 28v 6kW D.C. generators, one driven by each engine. A.C. supply for propeller and intake de-icing is provided by two Viscount-type 7.3kVA 208v alternators. The split-busbar arrangement of the earlier Herald is continued in this aircraft and, if a complete fault to earth develops, essential services can be operated for 90 minutes on the stand-by batteries that have been added for self-contained starting. Handley Page seem to have taken A.R.B. requirements on this score very

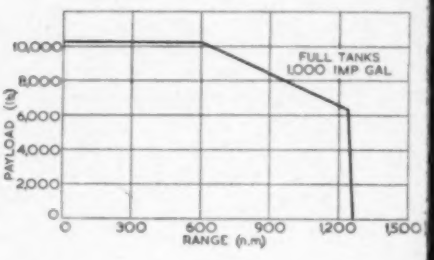
DART HERALD . . .



Operating costs are based on the S.B.A.C. standard method, Issue 3, and assume a passenger unit weight of 213 lb in the 36-seat aircraft. An annual utilization of 1,500 hr is assumed, with an eight-year depreciation life to 20 per cent of first cost. Engine overhaul life of 1,200 hr and propeller overhaul life of 1,500 hr has been used.



Take off field length is that specified in B.C.A.R.s, 1956. Still air, hard, dry and level runways and 98 per cent engine power are assumed. A small amount of water methanol at I.S.A. temperatures is anticipated.



Range and payload performance is based upon the 36-seat Dart Herald, I.S.A. conditions and still air. Allowance is made for take off from s.l., climb to cruising height, cruise at 17,400ft and descent to sea level.

seriously, and claim that no other twin-engined aircraft can equal the Herald's safeguards against electrical failure.

Within the pressurized cabin volume of 2,075 cu ft the standard seating arrangement is 36 in nine rows of two double chairs at a comfortable 38in pitch. An alternative version with a triple seat at the rear of the cabin will carry 43, and as this is less than weight-limit payload it may be possible to devise higher density versions. The layout is flexible and the cabin can quite rapidly be adapted to carry part or full freight; strong freight areas equipped with lashing points are stressed for 150 lb/sq ft loading and the remainder of the floor to 100 lb/sq ft. A total volume of 1,682 cu ft is available for freight. There are two emergency exits on the starboard side, a forward one 2ft 9in high by 1ft 10in and a rear one 4ft 2in by 2ft and extending down to floor level.

In the mock-up at Reading are new low-backed double chairs which improve the impression of spaciousness in the cabin, new panelled roof luggage racks (replacing the collapsible "cat's cradle" design), and a rear loading door (64in × 65in) split horizontally and hinged top and bottom. The lower half contains built-in passenger steps. Another type is a single passenger door with built-in steps and a separate luggage hatch. The crew entry door doubles as a second freight door; it is large enough to accommodate wool bales or oil drums.

A new application recently proposed for the Dart Herald is that of airborne radio and radar-equipment calibrator. Checking Europe's network of V.O.R.s alone is going to require several full-time calibration aircraft and there is a definite, if limited, need for such machines elsewhere in the world.

The Dart Herald obviously fits this subsidiary rôle remarkably well. The operating ceiling is about 37,000ft at 27,000 lb gross weight and the range can be increased to an absolute maximum of 2,467 miles at 30,000ft (or nearly 11 hours' endurance) with a 400 gal tank installed in the pressure cabin or in slipper tanks under the wings. Without detailing the various items of equipment that could be carried—a wide variety is obviously possible—much calibration gear could be installed in special racks.

Since the Dart Herald is inevitably the subject of comparison with the Friendship, it is well worth briefly re-examining not only the performance but the application of the two rival designs. The Friendship is sleeker aerodynamically; but having less power it may show a slightly lower average cruising speed. There is very little to choose in the take-off performance of the two aircraft; the Herald has a shorter run, the Friendship may have a slight edge on the distance to 50ft. The Herald can probably show an all-round advantage, since its tyre pressures are lower and its balanced field-length performance is better. Also, the Herald's payload-range curve extends a little further than that of the Friendship, and Handley Page claim that over a 230-mile stage the direct operating cost is appreciably less; over 800 miles costs are similar. Very important is the point that the Herald is offered at a first cost at least £35,000 less than its Fokker counterpart; great efforts have been made to keep development costs low.

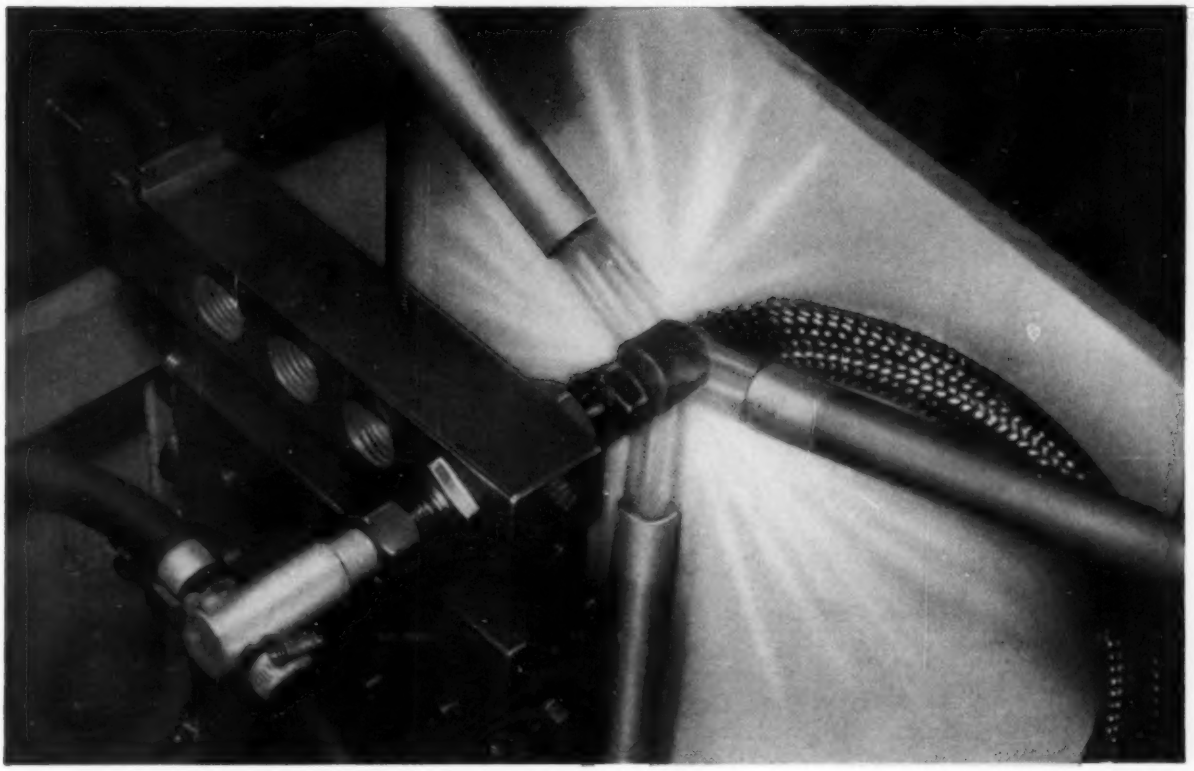
The Herald (say Handley Page) "is not an aerodynamic wonder." It has a light, but tough and robust structure, amply provided with access doors and maintenance panels. The airframe overhaul life should start at 1,500 hr, the Dart RDa.7 at 1,200 hr. Few countersunk rivets have been used, because the mushroom-headed type are lighter and easier to replace when repairs have to be made. It is very much designed to be a working aeroplane for many years after it goes into service.

Handley Page have also given a great deal of thought to the service that they can give to Herald operators. Experience with the Marathon helped to develop techniques of organization and supply that it is intended to implement in after-sales service with the Dart Herald. The company are starting from the cautious premise that in this particular field long experience is all-important, and they are taking full responsibility for the 24-hour availability of *all* spares in a central stock held at headquarters and in regional depots. This is in addition to regular visits to operators by technical representatives, an H.P. engineer on attachment, and interchange of information—the normal minimum of servicing assistance. The company are also to extend their technical instruction to courses on the Dart Herald. The Rolls-Royce organization will provide service and over-the-counter spares.

As related earlier, the background to Handley Page's Dart Herald is such that the firm have no illusions about the product that they are offering to the world's short-haul airlines. Searching questions from prospective operators and the spur of competition have left little of the Herald's potential unexplored. The merit of the aircraft shows up well under such close examination and it is upon this that the company are satisfied to base their hopes for the future. There is a very considerable market for aircraft to replace the many DC-3s still in service, and Handley Page are determined that the Herald shall obtain a generous share.

Taken at Woodley recently, this photograph emphasizes the Dart Herald's large dihedral and the sharp lines of the lower fuselage chine.

Tests prove Plessiflex meets A.R.B. & American C.A.A. fire requirements



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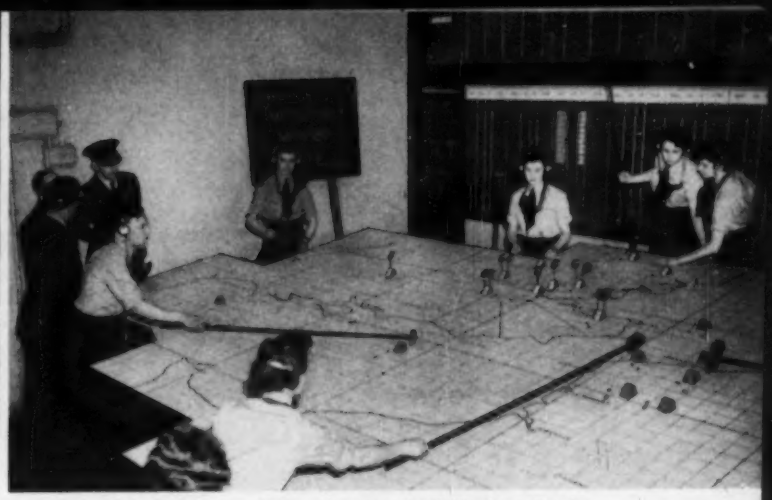


Air Chief Marshal Lord Dowding, A.O.C-in-C. Fighter Command during the Battle of Britain, unveiled a plaque on April 22 above the site of No. 11 Group Operations Room (which is now to be put to another use) at Uxbridge. With him in the left-hand picture is the present A.O.C. of No. 11 Group, A.V-M. V. S. Bowling, and on the right they are seen in the operations room, manned as it was during the battle.

SERVICE AVIATION

Royal Air Force and Naval Flying News

R.N.Z.A.F. Command

A NEW Chief of Air Staff of the R.N.Z.A.F. has been appointed. He is A. Cdre. M. F. Calder, at present V.C.A.S., who on July 1 is to succeed A.V-M. C. E. Kay as C.A.S. and will be promoted to air vice-marshal. A.V-M. Kay, who has been C.A.S. since 1956, is retiring from the Service.

A. Cdre. Calder was appointed V.C.A.S. in December 1957 and prior to that was S.A.S.O. at No. 224 Group H.Q. in Malaya, on an R.A.F. exchange posting. Before going to Malaya he was in London as A.O.C. at R.N.Z.A.F. Overseas H.Q.

Maintenance Command Post

DIRECTOR of Guided Weapon Engineering at the Air Ministry since last September, A.V-M. D. W. R. Ryley is to become A.O.A. at Maintenance Command from July 1.

He was the first commandant of the R.A.F. Technical College at Henlow, Beds, on its formation in August 1949; then in January 1952 he was appointed Senior Technical Staff Officer at Coastal Command, going from there to Air Ministry as Director of Armament Engineering (the previous title of his present post) in February 1954. Promoted to his present rank on January 1 this year, A.V-M. Ryley was made C.B.E. in 1944 and C.B. in 1956.

Andover Appointment

FORMERLY commanding No. 1 School of Technical Training at R.A.F. Halton, A. Cdre. E. D. McK. Nelson took over last Friday (April 25) as Commandant of the R.A.F. Staff College at Andover. He had previously been on the directing staff of the R.A.F. Staff College at Bracknell and among his wartime appointments (when, until 1943, he was concerned with armament duties) were command of No. 103 Sqn. and of R.A.F. stations Blyton and Waddington. A. Cdre. Nelson boxed for the R.A.F. between 1932 and 1939, competed in the R.A.F. Modern Pentathlon Championships of 1954 and was an aide-de-camp to the Queen from 1953 to 1957.

Cadet Exchanges

FORTY-FIVE delegates, representing 16 nations, agreed at a three-day conference which ended at Air Ministry on April 24 that an international exchange of air cadets should be held during July and August. Fifty U.K. cadets (aged 16 to 18) are to cross the Atlantic—25 going to New York on July 21; 25 to St. John's, Newfoundland, on July 19—and in the same week ten more are to visit the Continent. During the same period a similar number of cadets from the U.S. Civil Air Patrol and the Air Cadet League of Canada and ten from Continental countries—including Turkey—are to tour the U.K.

The British cadets are to return from Washington on August 8 and from Montreal on August 11. They are flying in U.S.A.F. and R.C.A.F. aircraft and the whole tour will be free to the cadets, none carrying more than £10 pocket money.

Net Result

A BRAKING device for aircraft, resembling a giant tennis net when stretched across the runway at the start of the overshoot section, has just completed a six-month test at R.A.F. Ahlhorn in West Germany. During normal flying this safety device—named "The Barrier" by 2nd T.A.F. pilots—lies flat on the runway; it is operated from flying control and can be raised within seconds when an emergency occurs. It consists of two steel cables attached to hydraulic drums on each side of the runway, with triple strands of half-inch nylon rope suspended vertically between the cables and so spaced as to grip the leading edge of an aircraft's wing but to pass clear of its nose and cockpit. The drums take up the tension as soon as an aircraft noses into "The Barrier," allowing the net to travel forward with the machine until it comes to a standstill. The manufacturers, a Swedish textile firm, claim to have stopped a nine-ton aircraft in 120yd after contacting the net at 120 kt. Completion of the assessment at Ahlhorn follows a SHAPE announcement that NATO airfields would be equipped with special braking devices to stop aircraft in difficulties on take-off or landing.

Coastal Command Reunion

THIS year's reunion of Coastal Command officers is being held in the officers' mess at H.Q. Coastal Command, R.A.F. Northwood, Middx, on Saturday, June 14, starting at 6 p.m. Dress is lounge suits and there will be a buffet supper; all officers who have served in the Command since September 2, 1939, are eligible to attend. Tickets (15s each) and any further information may be obtained from the hon. secretary, W/C. P. A. Ostle, at H.Q. Coastal Command.

IN BRIEF

The R.A.F. is to meet Cambridge University in an athletics match at R.A.F. Uxbridge tomorrow (Saturday, May 3).

* * * * *

Between May 14 and October 19, forty airmen a week from R.A.F. Geilenkirchen in 2nd T.A.F. are to make coach trips to Brussels to visit the International Exhibition.

* * * * *

No. 470 (Falkirk) Sqn., A.T.C., rifle team won the *Punch* Trophy at Uxbridge on April 19 for the tenth time in eleven years of competition between the A.T.C. and boys of the Sea Cadets and the Army Cadet Force. The squadron gained 969 points out of a possible 1,000.

* * * * *

Cdt. Sgt. David Hood of No. 1141 (6th Edinburgh) Sqn. of the A.T.C. has qualified for the gold medal, highest honour in the Duke of Edinburgh's awards scheme for youths, and becomes the first Service cadet to do so. His squadron has won 24 other awards since the scheme started in 1956—six silver and 18 bronze medals.

A. Cdre. E. W. S. Jacklin, C.A.S. of the Royal Rhodesian Air Force, who has been promoted to air vice-marshal and thus becomes the first member of the R.R.A.F. to hold that rank.

Lord Brabazon, at the Royal Aero Club a.g.m. (see first news-item) presents the Bréguet Trophy to Mr. Raoul Hafner (left) and an R.Ae.C. Silver Medal to W/C. C. E. F. Arthur. In the foreground is the Britannia Trophy, which went to Mr. Michael Randrup.

CLUB AND GLIDING NEWS

SUMMING-UP the Royal Aero Club's 1957 aviation activities at the club's a.g.m. on April 23, the chairman, Mr. S. Kenneth Davies, said, "The club has taken a firm line to assert the rights of light-aircraft users to a fair share of the air unencumbered by unrealistic regulations, and we will continue to lead the fight with vigour." One of the first results of the formation of the club's Aviation Committee in January 1957, he recalled, had been the joint symposium at which private pilots had discussed their problems with M.T.C.A. and other officials.

"The results in concrete achievement were disappointing," Mr. Davies continued, "but it is felt that the officials did get a first-hand view of the problems which beset our sort of flying today and a warning that we are not prepared to be legislated out of the air. . . . We have also busied ourselves with the problem of Croydon Airport, the closure of which is scheduled for next September. In spite of all efforts the Minister has remained adamant, and so far will not reconsider his decision. Private and business aircraft users are therefore forced even further from the centre of London and will have to accept less adequate services at Biggin Hill in future. The closure of Hendon to private aircraft, following immediately upon its inclusion in the special concession scheme introduced during the year, was also a severe loss to pilots visiting London, but we are still hopeful of some arrangement being made."

Continuing his review, Mr. Davies outlined the recent progress of the club's affiliated organizations, including the British Gliding Association, the Society of Model Aeronautical Engineers and the Popular Flying Association. The Coventry Victor Flying Neptune engine had shown considerable promise when installed for flight tests in the P.F.A. Turbi aircraft, and further modifications would be made to this power unit in the coming year. Following airframe modifications the Turbi would be flying with a Continental engine during this summer and, it was hoped, would visit many groups and airfields. The Kemsley Flying Trust was "one of the greatest assets of light aviation today," the chairman continued, although it was not one of the club's direct responsibilities. During its first decade, completed in September last year, the Trust had provided loans totalling £145,700 for a variety of purposes. Mr. Davies concluded his report by referring to the sudden death of Air Chief Marshal Sir John Boothman, vice-chairman of the club, on December 29 last. A special portrait of Sir John had been painted by Mary Eastman, and had been presented by Kelvin and Hughes, Ltd., to the club.

Following the chairman's report, the president of the club, Lord Brabazon, announced that Mr. Kenneth Davis had decided with regret to resign his chairmanship. Lord Brabazon thanked Mr. Davies on behalf of the club for his services as chairman during the past five years, and then presented the club's trophies for 1957.

The Britannia Trophy was awarded to Mr. Michael Randrup and Mr. Walter Shirley for their aeroplane altitude record of 70,310ft. Royal Aero Club Silver Medals went to W/C. C. E. F. Arthur, C.F.I. of Fair Oaks Aero Club; Lt. Col. A. J. Deane-Drummond for his series of record glider flights; and Capt. E. E. Fresson, pioneer of the Scottish air ambulance services. The club's Bronze Medal was awarded to Harry Harper, pioneer aviation journalist. Messrs. Randrup, Deane-Drummond and Harper were unable to be present.

In the absence of John Cunningham, the de Havilland Trophy for last year's Comet record flights to Khartoum and Johannesburg was received by co-pilot Peter Bugge. Mr. Raoul Hafner, awarded the Louis Bréguet Memorial Trophy, received a silver replica of a gannet; and Paul Tissandier Diplomas of the F.A.I. were presented to Mr. F. N. Slingsby, Mr. Peter Masefield and Mr. Denis Lyons. The fourth British recipient of a Tissandier diploma, who had received the award at the recent F.A.I. meeting in Los Angeles, was Mr. S. Kenneth Davies.

INSTRUCTIONAL lectures on elementary gliding are to be given by Derek Piggott, C.F.I. of the Lasham Gliding Centre at the Kronfeld Club, London, during next month. Intended primarily for newcomers to gliding, the lectures will be held on Tuesdays (beginning on May 6 and ending on May 27) at 8 p.m. The four sessions will deal respectively with first training flights, stalling, launches and landings, and soaring, and the fee for the full course is 10s. Application forms are available from the British Gliding Association, Londonderry House, 19 Park Lane, London, W.1.

SYWELL is the aerodrome at which the Tiger Club's aerobatic competition for the de Havilland Trophy will take place on Sunday next, May 4. Among the entrants is Charles Boddington, the present holder of the trophy. Also on the programme at Sywell are formation and racing displays by the Tiger Club; a triple drop by the British Parachute Club; and, it is hoped, aerobatics by C. Nepean Bishop in Rollasons' new "Bishop" Tiger Moth conversion. Monday, May 12, is the final date for entries for the Monday, May 26.

WINNERS of the Lancashire Aero Club's landing competitions last month were: F. M. Emery, Rodman competition for senior members; H. Burrows, Pemberton competition for junior members; and D. Westoby (of the Northern School of Aviation, Blackpool), Hart competition for visiting clubs.

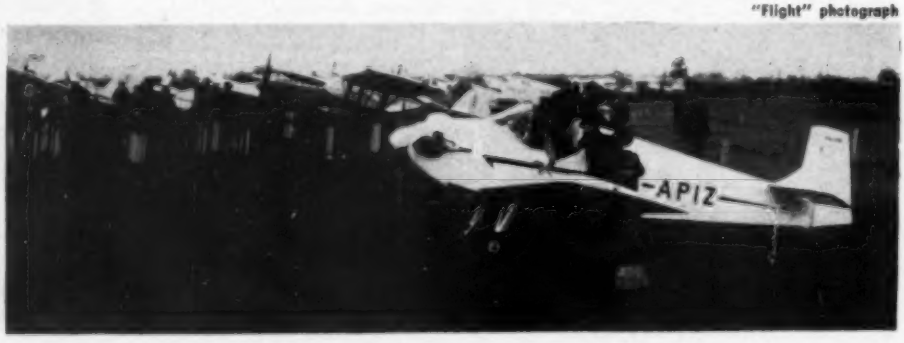
FIRST flight of the Elliotts Olympia 415 sailplane was made by David Ince from Lasham last Sunday. A fifteen-metre version of the larger 419, the 415 is to be flown in the standard class of the World Gliding Championships at Leszno by Cdr. Anthony Goodhart, R.N.

LAST Sunday, also, Mr. Lorne Welch, flying solo in a T.42B, made (subject to confirmation) a Diamond goal flight of 188 miles from Nympsfield, near Bristol, to Lympne in Kent; his turning points were Bicester and Alton.

DATE of this year's national sailplane aerobatic contest at the Dunstable site of the London Gliding Club will be Sunday, September 21. Following Silver C and elementary soaring courses for members at Dunstable during recent weeks, the club's general programme of courses has now begun.

ALL-METAL and vee-tailed, the new Russian A-13 single-seat sailplane recently began flight tests. It is the product of a group of Soviet designers led by Oleg Antonov, and features two interchangeable pairs of wings. One, it is reported, is for aerobatics; and the other for high efficiency in long-distance soaring.

"Flight" photograph



The first "aircraft sales weekend," organized by W. S. Shackleton and Goodhew Aviation at Kidlington last Saturday and Sunday, attracted considerable interest among private and potential owners. The aircraft offered for sale ranged from two Turbulents—one of which is seen here—to a Dove and a Bristol Sycamore helicopter.

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News of TACA VISCOUNT Experience

Ricardo H. Kriete, President of TACA International Airlines, announced recently in San Salvador that in the first six weeks of operation over its routes the Vickers Viscount has shown encouraging traffic trends.

"On certain routes the load factor has been as high as 86%. The load factor over all routes on which the company operates the Viscount schedules has been 73%. Passenger reaction in our area has been most enthusiastic for the new jet-prop aircraft," said Mr. Kriete.

Pilots have many reasons for preferring the Viscount with its proved and reliable non-powered flying controls.

Viscount experience in service with over 20 airlines is being built into the simple functional cockpit and cabin layout of the new Viscount 810-840—ensuring for both pilots and passengers that comfort and freedom from strain which is now associated with Viscount travel. In this new Viscount the proved dependability of the airframe and the Rolls-Royce propeller-turbine, after ten years of development and 1½ million flying hours, means peace of mind for both crew and passengers. Quiet, smooth flight reduces fatigue and improves efficiency, while the rapid turnround due to ease of maintenance means less worry over schedules.

There is no substitute for experience

VICKERS-ARMSTRONGS (AIRCRAFT) LIMITED WEYBRIDGE SURREY
TGA AT548C

The world's most impressive transport aircraft production line must surely be this one, at the Boeing transport division, Renton. Here may be seen seven aircraft approaching final assembly—three on the left for PanAm, three on the right for American. Both airlines plan to begin scheduled services before Christmas. The certification programme, originally due to be completed in December, is reported to be two or three months ahead of schedule.

CIVIL AVIATION

B.O.A.C.'s BIG DEFICIT

THOUGH B.O.A.C.'s chairman prophesied last September that 1957-58 would be "a difficult year," the news last week that the Corporation had ended the financial twelvemonth with an estimated deficit of about £2¼ millions came as a shock. B.O.A.C. has not made a loss since 1952-53: even the Comet 1 disasters of 1954—the biggest commercial setback ever suffered by the Corporation—did not result in a deficit.

Two explanations are given by B.O.A.C. and by the Minister of Transport: (1) Revenue has not come up to expectations—"the main cause"—due to the "late delivery of new aircraft," and also to a recession in traffic growth; (2) engineering costs have "seriously affected the Corporation's finances."

No financial or traffic results for 1957-58 have been given, and a full examination of B.O.A.C.'s year must await their publication late in the summer (probably in July, two months earlier than usual).

In the meantime, these reasons for the deficit are worth examining. A shortfall in revenues is given as the main cause. There were indeed signs of a decline in load factor during the *calendar* year 1957, in which a figure of 62 per cent was recorded. Load factor in the previous financial year, 1956-57, was 63.7 per cent. Profitability, in B.O.A.C. or in any airline, is highly sensitive to load factor, as the Corporation's results last year vividly illustrated. (In 1956-57 a two per cent increase in load factor transformed an estimated £1½ million loss into a £300,000 profit.) So if B.O.A.C.'s load factor dropped by, say, one point in 1957-58, anything up to £1½ million shortfall in revenues might have resulted.

According to B.O.A.C., traffic has not been forthcoming as expected from those countries "suffering from the fall in commodity prices," and the Corporation comments also upon a temporary winter decline in North Atlantic traffic, due, "no doubt, to the recession in America." So far as the first point is concerned, it is worth noting that total world traffic in 1957 increased, according to I.C.A.O., by 14 per cent, only 0.4 per cent less than in the previous year. The fall in world commodity prices therefore appears to have had little effect on the use of air transport in general. The temporary winter decline in North Atlantic travel was probably more of the airlines' own making than due to the American economic recession: the prospect of economy fares probably caused many travellers to postpone their plans until their introduction on April 1. So, all in all, it seems fair to comment that a recession in traffic growth was not the main cause of B.O.A.C.'s deficit.

Probably, too, the shortfall in revenues due to the "late delivery of new aircraft"—a reference to Britannia 312 delays—was not as serious as the Corporation had at one time feared. The Britannia 102 fleet was in full service throughout the year, the delays in introducing this version having been reflected in the 1956-57 results. It is worth noting that the Britannia 102 made a net profit on the routes which it operated (to Australia, South Africa, and the Far East) in 1957-58. The profit was certainly no less than that achieved by Argonauts and 749s in the previous year, and probably rather more—which is as it should have been.

The delays in mounting Britannia 312 transatlantic services—inaugurated in December after two postponements—were probably reflected more in costs than in loss of revenues: B.O.A.C. have been well covered with DC-7C and Stratocruiser capacity, pending the time—probably just about now—when the 312s are earning their keep.

Certainly the foregoing adversities contributed in part to the £2¼ million deficit; but probably the biggest contributions were made by (1) high capital charges, and (2) high internal costs. Dealing with these items in turn, of the total £2¼ million deficit, no less than £2 million was due to interest on issued capital, advances from the Treasury and bank loans. This interest is 36 per cent more than that paid last year, and 70 per cent more than was paid two years ago. This is the price of the world's heaviest airline re-equipment programme.

So far as internal costs are concerned, the present unhappy situation, discussed last week, is that the unit costs of B.O.A.C.'s maintenance and overhaul work are nearly double those of most American and European competitors. The plain fact is that B.O.A.C. will never be profitable, and able to ride temporary business adversities, until these costs are cut. Last year the Corporation spent £11½ millions on engineering maintenance and overhaul—25 per cent of total costs, compared with about 15 per cent spent by competitors. This is the hard fact which the management is now having to face. It is not pleasant for an airline to have to dismiss nearly a half of its engineering staff—3,150 men over the next two years, 650 of these during the next few months. For such drastic measures to be taken in an expanding business is a fairly plain admission of past mistakes, and it is small wonder that the men concerned appear at the moment to be in no mood to accept what has to be done.

SANDWICHES à l'I.A.T.A.

THE thought of grown men hurriedly meeting to discuss the definition of a sandwich has caused a certain amount of amusement within and without the air transport world. The circumstances are now well known: PanAm complained that certain of its North Atlantic competitors were not playing the game, and were offering their economy-class customers a mouth-watering repast instead of the simple sandwich agreed upon.

This is the old, old story of quality competition: in fixed-price conditions, the airlines quite naturally devise frills and come-ons to lure custom. This is the reason for the existence of I.A.T.A.'s Breaches Commission, which has managed to preserve a certain dignity over the latest sandwich affair. Here is its recipe for sandwiches, announced last week:—

"(a) [They] may be of the 'open' or 'closed' variety; (b) each to be a separate unit, the whole meal not to give the appearance of a cold plate; (c) a substantial and visible part of each unit to consist of bread, roll, or similar bread-like material; (d) each unit to be cold; (e) each unit to be simple (i.e., not complicated) and unadorned—this calls for a minimum of garnishing; (f) each unit to be inexpensive: this calls for avoidance of materials normally regarded as expensive or luxurious (such as—for example, but without limiting—smoked salmon, oysters, caviare, lobster, game, asparagus, *paté de foie gras*), and also for avoidance of

America's C.A.A. has now granted an airworthiness certificate to four types of foreign turbine airliner. Here, following those previously granted to the Viscount 700D, Friendship and Britannia, is the certificate for the Viscount 810, which Continental will put into service on May 28. In this photograph, from left to right, are seen:—Mr. G. F. H. Hemsley, assistant chief engineer, Vickers-Armstrongs (Aircraft); Mr. R. B. Meyersburg, chief of aircraft engineering (international), C.A.A.; Mr. T. Gammon, deputy managing director, Vickers-Armstrongs (Aircraft); Mr. O. R. Haveter, vice-president operations, Continental Air Lines.

Mr. Harold Watkinson, Minister of Transport and Civil Aviation, cutting the tape to open the 1,100ft runway extension at Manchester Airport on April 23 (see Col. 1). With him are the Lord Mayor, Ald. Leslie Lever; the Lady Mayoress; Ald. T. Regan, chairman of the airport committee; and Ald. J. E. Fitzsimons, deputy chairman.

CIVIL AVIATION . . .

over-generous or lavish helpings of permissible commodities, such as meats, which affect the money value of the unit and destroy the necessary conditions of low cost and simplicity."

This scuffle over a sandwich, though wearisome to those who had hoped that the airlines would all enter the low-cost spirit of economy travel, is the inevitable result of price-fixing; but it is preferable to the economic and political chaos that would result from free competition. We just wonder whether the *brouhaha* would ever have taken place had I.A.T.A., in defining economy-class catering, agreed (a) to fix the *price* of food per passenger, (b) to limit the weight and space of catering equipment, and (c) to limit the number of cabin staff.

MANCHESTER PROGRESS

ON St. George's Day, and in sunshine bright enough to have moved Shakespeare to a birthday sonnet, an 1,100ft extension to the main runway at Manchester Airport was opened by Mr. Harold Watkinson, Minister of Transport and Civil Aviation; and he also unveiled a plaque commemorating the start of work on a new terminal building, thus for ever enshrining his name at Ringway (like Sir Sefton Brancker's at Croydon) for posterity to read. The extension brings the total length available to 7,000ft and B.O.A.C. (who since 1955 have been using the U.S.A.F. base at Burtonwood) resumed transatlantic operations from Manchester last Sunday. The terminal is due to be completed in 1960.

At the unveiling, and later at luncheon in Manchester Town Hall, Mr. Watkinson was treated to some forthright Mancunian comments on Ringway's importance after L.A.P. as this country's second international airport. Ald. Tom Regan (chairman of the city's airport committee and a veteran of the days when first Wythenshawe and then Barton were Manchester airports and when the decision to start Ringway was only approved by one vote) said the city would like to know whether Ringway was to be developed to take jets. "We are looking forward to the new jet era," he said, "and we cannot afford to miss it. We brought the sea to our doorstep [a reference to the Manchester Ship Canal]; we are now being challenged by the air and we are going to beat that." Ald. Regan quoted Ringway's vital statistics—3½-14½-57—in support of his favourite airport: Aircraft movements had increased three-and-a-half times; passenger handling had multiplied 14½ times; and in '57 the freight tonnage handled had gone up to over 9,000. Manchester was "a clearing-house" for the great north-western conurbation; its name spelt "commerce."

Mr. Watkinson proved not unsympathetic to the city's claims *vis-à-vis* Prestwick; indeed, both he and Ald. Regan savoured the word "partnership" to describe the cordial relations between municipality and M.T.C.A. But the Minister laid two restraining arguments before the enthusiastic city fathers—the national economic position (with its governmental corollary), and the problem of high noise-level with jet aircraft. Building a runway of the required length at Manchester would be "very, very expensive"; and solving the noise problem was a prerequisite before bringing jets into a built-up area such as Ringway.

The new terminal, which will employ the finger-and-pier system as at Gatwick, is to include an apron accommodating 22 aircraft and a new control tower 130ft high. The structure will be erected on a foundation of reinforced concrete piles and in the finished building there will be complete separation between passenger flow and baggage flow.

COMET COME-BACK

AS recorded in a photograph on page 590, and another opposite, the first new Comet for airline service began maker's trials at Hatfield last Sunday evening, just a little over four years since the Series 1 version was withdrawn in April 1954. Behind the new Comet 4, to quote a D.H. statement last week, are more than 50,000 hours of test and operational flying and "a programme of scientific proving and ground testing which is unprecedented in aviation history." This programme, and the plans for the future, were discussed in a special feature in *Flight* of March 28.

The crew on board G-APDA for the maiden flight were John Cunningham, D.H. chief test pilot; Peter Bugge, co-pilot; E. Brackstone Brown, flight engineer; J. L. Johnston, flight observer; and J. Marshall, instruments observer.

The Comet 4 will immediately embark on its C. of A. test programme, about 80 per cent of which has been completed by the Comet 3 G-ANLO. Deliveries of production aircraft to B.O.A.C. are due to begin in September, and B.O.A.C. expect to receive four aircraft before the end of the year, followed by one or two more during January. Present plans are for B.O.A.C. to inaugurate passenger services to Australia on February 1, 1959; there is, however, a possibility that Comets will be used to operate token British jet services across the North Atlantic should PanAm—as appears highly probable—introduce Boeing 707-120s into North Atlantic service in the autumn. (PanAm's target date for the introduction of a one-stop service between New York and London is reported as being November 1.)

The introduction of Comet 4s into North Atlantic service, also as a one-stop operation, should be operationally and commercially feasible, though it would entail some disruption of B.O.A.C.'s carefully prepared programme of pre-service Comet flying. The Corporation had intended to fly no less than 1,500 Comet 4 hours before the first passengers were carried, 100 of which would go towards meeting the A.R.B.'s certification requirement. (This calls for a minimum of 250 hours before full normal category certification, of which at least 100 shall be under operational route-proving conditions.)

The appearance of the Comet 4 coincides with an awakening interest in the aircraft; hopes of selling to T.E.A.L. and Aerolineas Argentinas are still not given up, despite the full pressure of American salesmanship in those countries. The very existence of the new Comet, and the impressive production lines from which the first has just issued, may well stimulate heightened interest.

TRANSATLANTIC SHAMROCK

LAST Friday, April 25, a new carrier—Irish Air Lines—made its transatlantic debut. It is the sixteenth airline to compete for the traffic moving between the Old World and the New. Though the industry's welcome to the Irish airline will be warm, it will perhaps be tempered with a certain disquiet: the appearance of the latest competitor is one more example of the way in which the air transport business is being diluted by new carriers.

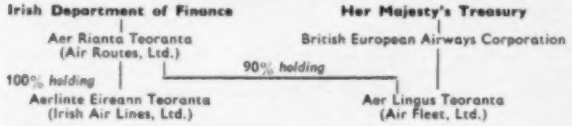
The company's venture, however, is not the result of impulsive nationalism. This is the third Irish attempt to establish transatlantic services, the first having been in 1935 and the second and previous attempt in 1947.

Flight of January 17 and February 14 last described the organization of Irish Air Lines, which will operate all-economy class services between Dublin, Shannon and New York with Super Constellation L.1049Hs chartered from Seaboard and Western. Frequency will be thrice-weekly, building up to once-daily in the autumn. Their aircraft will be painted in green and white; fins and rudders will be striped and will incorporate a shamrock. The central fin will bear the Eire flag. United States registration numbers will remain, but the aircraft will have Irish names inscribed in Irish script.

The Shannon - Dublin - Shannon sector of the service will actually be operated by Aer Lingus, Aerlinte's sister airline, as subtenants of the L.1049Hs. The reason for this administrative Irishism is obscure: probably it is because, so long as PanAm cannot operate beyond Shannon into Dublin, the Aerlinte service must appear—on paper at least—to terminate at Shannon. In fact Irish Air Lines' passengers from New York—which has half a million Irish—will be able to fly straight through to Dublin, and *vice versa*, without changing aircraft. Shannon appears to be fighting a losing battle against technical progress: increased aircraft range is diminishing its importance, and it could well be that Irish Air Lines' transatlantic competitors will soon start to clamour for rights into Dublin. Probably the C.A.B. would support PanAm in such a move.

First flight—and first air-to-air pictures—of the first Comet 4 were made last Sunday. The following day the aircraft was airborne again for nearly two hours and should be flying regularly from Hatfield for the next three months when overseas trials will begin. Thrust reversers on two of the Comet 3's Avon RA.29s were flown for the first time last Saturday, with demonstrably satisfactory results.

For the record, the following *aide-memoire* should help to clarify the position of the new airline in relation to Aer Lingus. Both companies operate under the English title of Irish Air Lines; have common technical and commercial divisions; and share a general manager, deputy general manager and secretary; but the constitution of their Boards is different. Aer Lingus are the general agents for Aerlinte in Ireland and—as already noted—operate the Shannon - Dublin - Shannon sector, as sub-tenants of the L.1049Hs, as well as supplying cabin service to Aerlinte.


Irish Department of Finance
Her Majesty's Treasury
Aer Rianta Teoranta (Air Routes, Ltd.)
British European Airways Corporation
100% holding
90% holding
Aerlinte Eireann Teoranta (Irish Air Lines, Ltd.)
Aer Lingus Teoranta (Air Fleet, Ltd.)

RATIONALIZING THE CODES

THE process of comparing the British A.R.B. and the American C.A.A. airworthiness requirements "line by line" (as Mr. R. E. Hardingham, A.R.B. secretary, has described it) entered a new and perhaps final phase last week. A delegation from C.A.A. visited London for talks with the A.R.B., following that authority's visit to Washington last December.

There can be few people in the air transport business who have not at times been exasperated by the discrepancies between the two codes. As the Ministry of Transport said last week, "The overall objectives of both countries are identical. Differences in method . . . have grown up over the years. But the advent of the turbine-engined aeroplane with its new problems opens the way for a major effort to align the methods."

At last there appears to be a good prospect of substantially reducing the differences, if not actually of eliminating them. Even if the last-named ideal compromise does not result, and the world's two major manufacturing countries still differ in their airworthiness codes, at least manufacturers and operators will know exactly where they stand in relation to the requirements of the other.

Chairman of the latest meeting was Mr. Walter Tye, the A.R.B.'s technical officer, and the United States' team, 16 strong, was headed by Mr. W. E. Koneczny, chief of the airworthiness division of the C.A.B. Each team included representatives from manufacturers, operators, government departments, and pilots.

THE PENALTY OF OVERWORK

FINES totalling £250 and costs were levied on Independent Air Travel and the company's pilots at Bournemouth last week for offences concerning flight-time limitations. All seven pilots charged pleaded guilty to infringing the fifth amendment of the 1954 Air Navigation Order; they had all exceeded 125 hours' flying in the previous 30 days and two pilots had to face additional summonses for having taken insufficient rest periods between flights.

Independent have gained a good many sympathizers during the case; the pilots were not flying additional hours to obtain a bonus (they are on a fixed salary-scale), no suggestion of lack of safety or crew fatigue on any flight was involved, and the company are quite small and perhaps unfortunate to be the first to be charged with a breach of these regulations. Mr. H. E. Lewis McCreery, representing Independent, said that aircrews were extremely hard to find and "my company and other companies are driven to the expedient of having people who fly for them only at week-ends and on one day a week."

It was admitted by Mr. F. E. Beezley, for the Director of Public Prosecutions, that the current flight-time regulations were "experimental in nature" and that Independent's accident record could fairly be described as "extremely good." Nevertheless, there could be no objection to a penalty against the carrier once a breach of regulations had been admitted; the limitations have been framed to safeguard pilots against exploitation as well as to protect passengers and crews from the effects of cockpit fatigue.

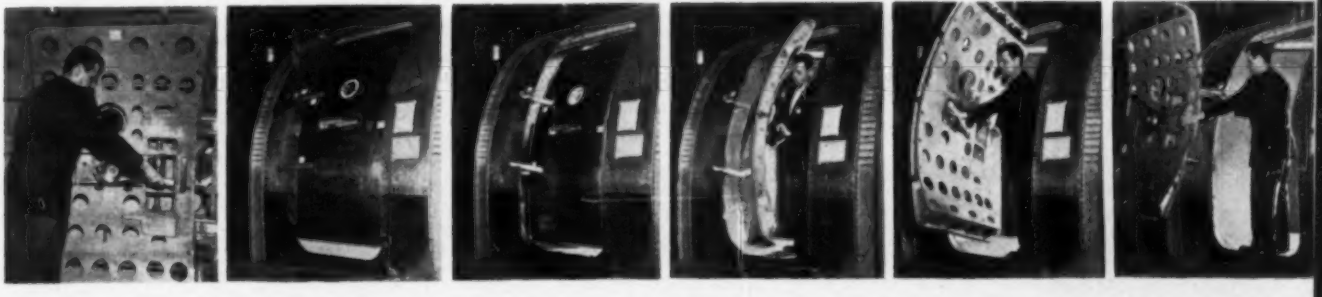
LONG-HAUL ECONOMICS

SWISSAIR'S experience in 1957 was discussed in *Flight* for April 4, as evidence of the immediate financial improvement invariably resulting from an increase in the average length of haul. The latest accounts for East African Airways provide yet more proof of this relationship.

For a number of years E.A.A.C. has been struggling to escape from the red. Operations have been based on DC-3 services running from Nairobi down to the coast at Mombasa and on to Dar-es-Salaam, but profits on this route have always been swallowed up by the losses involved in maintaining less densely travelled routes. A few years ago the company embarked on a long-distance service to Durban via Rhodesia, but although this venture showed modest profits, limitation of frequency and fierce competition from trunk airlines prevented this from significantly affecting the Corporation's results.

Last year saw E.A.A.C. start services between East Africa and the U.K. using three Argonauts purchased at reasonable terms from B.O.A.C. (A fourth aircraft has recently been added to the fleet.) The effect of this has been startling. After payment of interest on capital, the Corporation has made a clear profit of £5,000. Internal traffic has remained static, but international traffic has more than doubled, average passenger haul having increased from 270 to 340 miles. A fall in average costs per c.t.m. from 47d to 43d has been accompanied by cheering improvements in productivity, output having increased from 350 to 475 c.t.m. per flying hour and from 6,000 to 7,000 c.t.m. per employee. In two other ways the situation has been improved by advent of the Argonauts. Additional capacity has permitted E.A.A.C. to delay replacement of their DC-3s. Probably more important is the access

As this series of photographs indicates, Boeing are taking no chances with the doors of the 707. The test programme planned by Boeing will see their newly designed outward-opening plug-type door being opened and closed at least 25,000 times before the aircraft goes into service later this year.



On the left is Sud-Aviation's second prototype Caravelle, seen making its debut at London Airport on Wednesday of last week. It had flown from Stockholm on an S.A.S. training operation after cold-weather tests in Sweden. On the right, distinguishable by its radar, is an ex-Capital Viscount 745 at Dublin—one of two recently leased by Vickers to Aer Lingus.

CIVIL AVIATION . . .

to mail traffic provided by a trunk service to Europe. While passenger traffic increased last year by 35 per cent over 1956, mail loads—carried at rates exceeding 100 pence per ton mile—rose by 53 per cent.

REALISTIC ACCOUNTING

AS from the start of this year, the C.A.B. has sought to bring about various changes in the accounting methods followed by American scheduled carriers. The intention is to ensure that annual accounts present a more accurate picture of an airline's financial situation to its shareholders. More specifically, the aim is to prevent management from deliberately inflating the apparent level of current expenditure by charging various costs against present operation which should logically be borne in later years.

The two most significant changes affect depreciation charges and progress payments to manufacturers. Until this year, depreciation methods varied widely as between airlines, some carriers—such as Eastern—depreciating their aircraft down to a residual value of about five per cent in as little as four years. The new regulation, which does not apply retroactively, stipulates that aircraft be depreciated on a straight-line basis over seven years to a residual value equivalent to 15 per cent of the original cost. If airlines choose to render their equipment obsolete by over-readiness to acquire new types, the cost of obsolescence under the new regulation will rightly have to be borne by the new equipment.

The second major change advocated by the C.A.B. is that interest on deposits paid to manufacturers for the purchase of flight equipment should be capitalized rather than charged as current expenditure. This again is aimed at preventing the level of present costs being prejudiced by items that do not relate to the present.

The amounts involved are far from being insignificant. During the first quarter of this year, American Airlines showed a net profit after taxes of $1.6 million. Under the previous accounting method this figure would have been only $0.3 million.

FOAMED-PLASTIC LIFEJACKET

A NEW type of lifejacket which appears to have highly effective flotation qualities was demonstrated at a London swimming-pool last week. Very little thicker than a leather jerkin, and made of plastic material, it is of multi-cellular construction with foamed-plastic separators between the cells, to which air is admitted through a ventile fabric panel near the waist. The jacket is thus able to "breathe," giving the wearer full freedom of movement. On immersion, fibres embodied in the panel at once swell, to form a seal preventing the escape of the contained air. The sequence is thus automatic, no action being required of the wearer.

One of the most convincing moments in the demonstration was when a man wearing the jacket under deep-sea fisherman's gear—oilskins, sou'wester and thigh-boots—and carrying two bricks in each hand, jumped from the 20ft diving-board into 8ft of water, to bob up again instantly and remain safely afloat. (A minimum of 38 hours' buoyancy is claimed.)

With further development—primarily, perhaps, the addition of a head-supporting collar—the jacket should have possibilities for aircrew or air-passenger use. The demonstration was arranged by Marksway Wear, Ltd., 22 Down Street, London, W.1.

BREVITIES

PACIFIC AIR LINES (formerly Southwest Airways) have increased their order for Fairchild F-27s from three to five. Trans-Australia Airways have exercised their option on six Fokker-built F-27s, their order now standing at 12.

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Linjeflyg is reported to have decided to replace its DC-3s with used Convair 340s rather than with Friendships or Dart Heralds.

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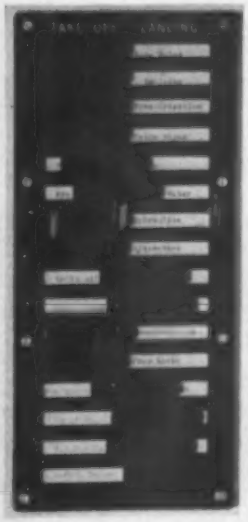
In the dispute between Central African Airways Corporation and Vickers-Armstrongs (Aircraft), Ltd., concerning the loss of a Viking in March 1953, the manufacturers have agreed to pay £125,000 damages.

* * *

The Caravelle has been undergoing cold-climate tests in northern Sweden. "Operation Snow-White" consisted of 20 flights totalling 45 flying hours. (See photograph above.)

* * *

Developed by International Aeradio, Ltd., of London, the cockpit-check board shown here can be either fixed in the cockpit or carried in the hand. It consists of a metal board having windows fitted with slides movable from one side to the other. When in the left-hand half each slide leaves the right-hand half open to show the appropriate item. As each part of the check is completed the slide is pushed over to the right-hand half of the window. When the sequence has been completed the slides are all in the right-hand position and the board is ready with the let-down check. The device is being adopted by Middle East Airlines.



Aerad's cockpit-check board, described above.

Silver City Airways recently carried the 100,000th passenger on their Blackpool - Isle of Man coach-air service.

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The C.A.A.'s certificate of airworthiness has been obtained by the Sud Djinn helicopter.

* * *

Lufttransport Union have acquired two DC-4s from Twentieth Century Aircraft.

* * *

The annual conference sponsored by the Air Transportation Committee of the American Institute of Electrical Engineers will take place this year in Buffalo on June 25-27.

* * *

On April 25 a C-46 owned by the Nicaraguan airline LANICA was stolen from Miami. Conflicting reports suggest the aircraft was flown either to Honduras or to Cuba.

* * *

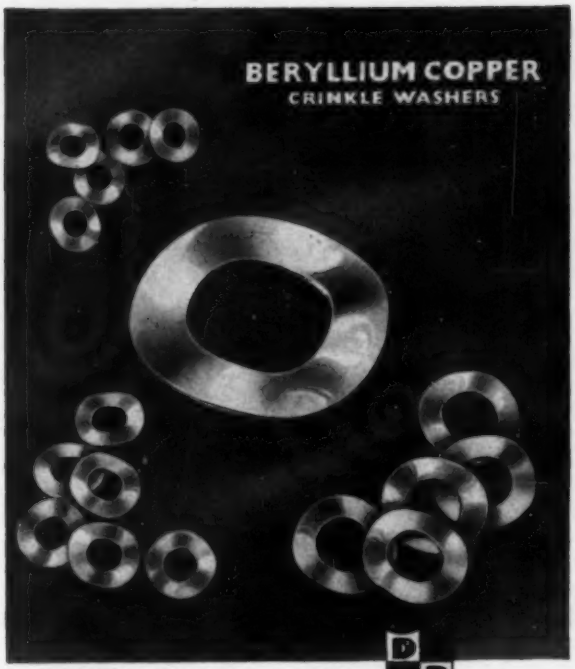
T.W.A. have sought C.A.B. permission for the lease or purchase of nine L.1049Hs from Hughes Tool Company. Five of these aircraft are at present being leased from California Eastern Aviation. The others have been ordered from Lockheed by Hughes Tool and will be purchased by T.W.A.

* * *

Lt-Cdr. G. O. Waters, C.B.E., chairman and managing director of Air Terminals, Ltd., since 1955, relinquished his post last Wednesday on medical advice. His position will be taken by Mr. A. C. Ping, a member of the B.E.A. Board. Mr. Waters joined Imperial Airways in 1929.

* * *

The British Petroleum Company has placed orders with Thompson Bros. (Bilston), Ltd., and Saunders-Roe (Anglesey), Ltd., for two prototype "Yorkshire" fuellers. Each will have a capacity of 10,000 Imp. gal, and will deliver at a maximum rate of 750 Imp. gal per minute.



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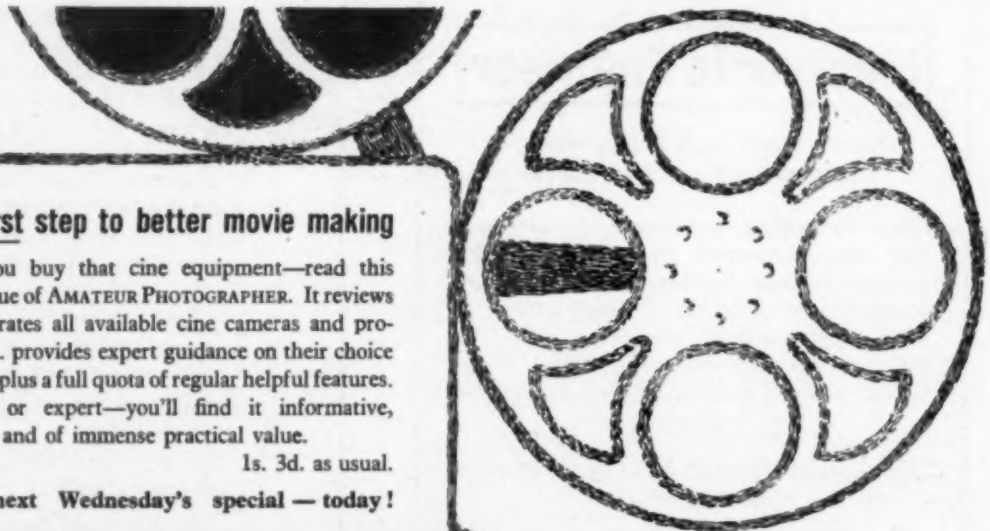

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APPLICATION No. 470/3 for an amendment to the terms of approval of the Normal Scheduled Service which they are authorised to operate on the route Leeds (Yeadon) - Southend (optional technical) - Dusseldorf, so as to enable them to operate on the route Leeds (Yeadon) - Southend (optional technical) - Rotterdam and/or Dusseldorf.

APPLICATION No. 1465/1 for an amendment to the terms of approval of the Normal Scheduled Service which they are authorised to operate on the route Newcastle - Basle, so as to enable them to operate on the route Newcastle - Rotterdam and/or Basle.

APPLICATION No. 1042/1 from Eagle Airways, Ltd., of 40, Edgware Road, London, W.2, for an amendment to the terms of approval of the Normal Scheduled Service which they are authorised to operate on the route London Airport and/or London (Blackbushe) - Lyons (optional technical) - Pisa from March to October inclusive each year, so as to enable them to operate the service throughout the year.

THESE applications will be considered by the Council under the Terms of Reference issued to them by the Minister of Civil Aviation on 30th July, 1952. Any representations or objections with regard to these applications must be made in writing stating the reasons and must reach the Council within 14 days of the date of this advertisement, addressed to the Secretary, Air Transport Advisory Council, 3 Dean's Yard, London, S.W.1, from whom further details of the applications may be obtained. When an objection is made to an application by another air transport company on the grounds that they are applying to operate the route or part of route in question, their application, if not already submitted to the Council, should reach them within the period allowed for the making of representations or objections. [7824

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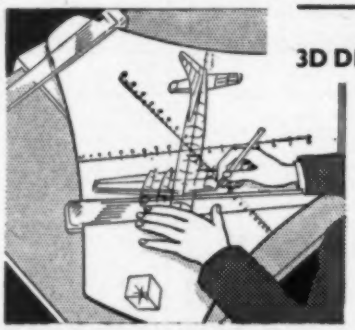

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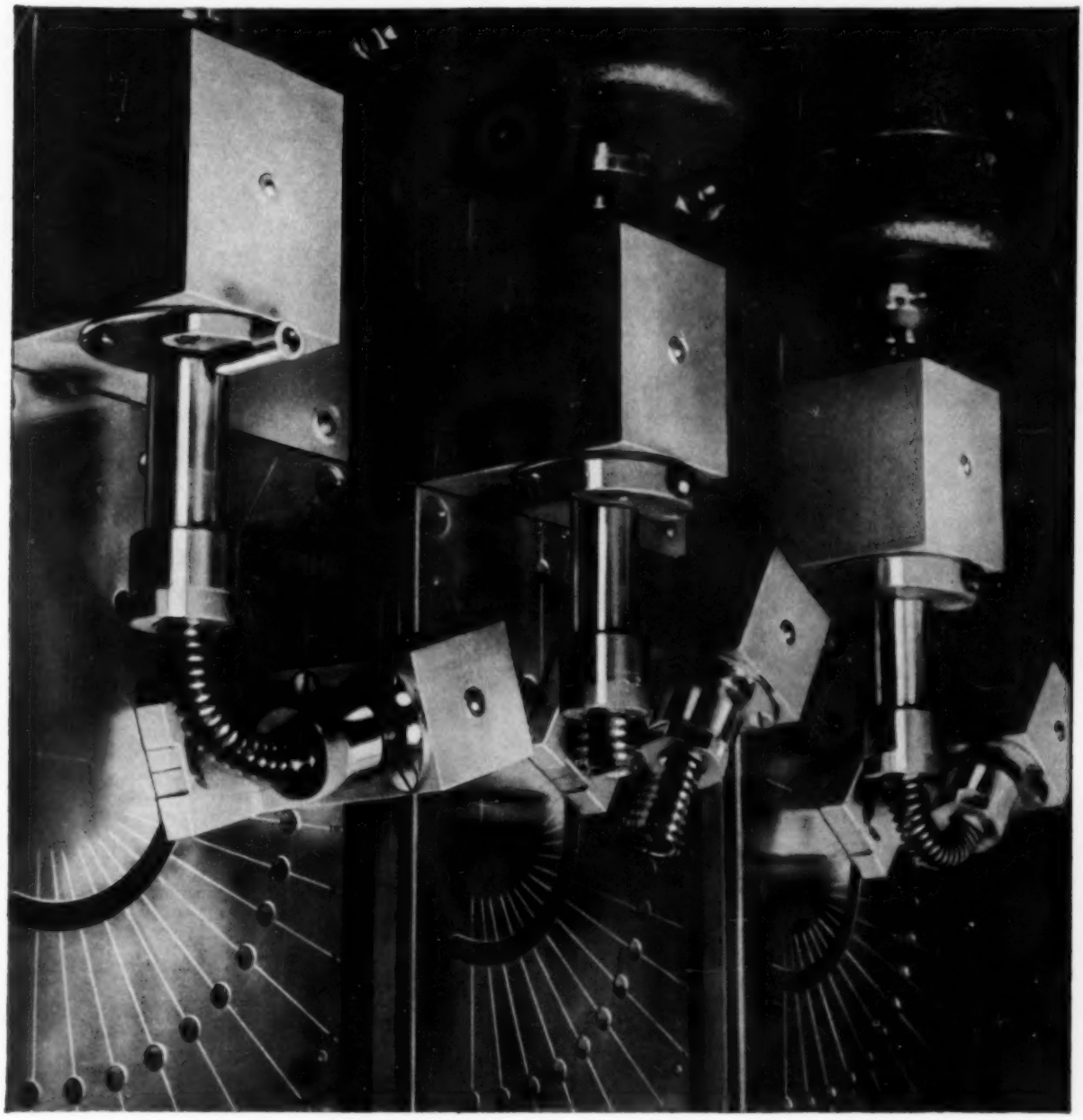

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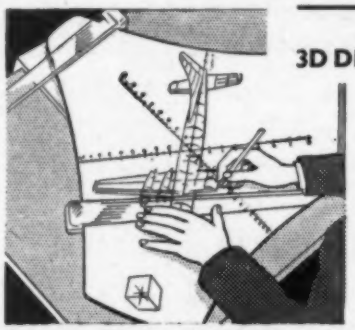

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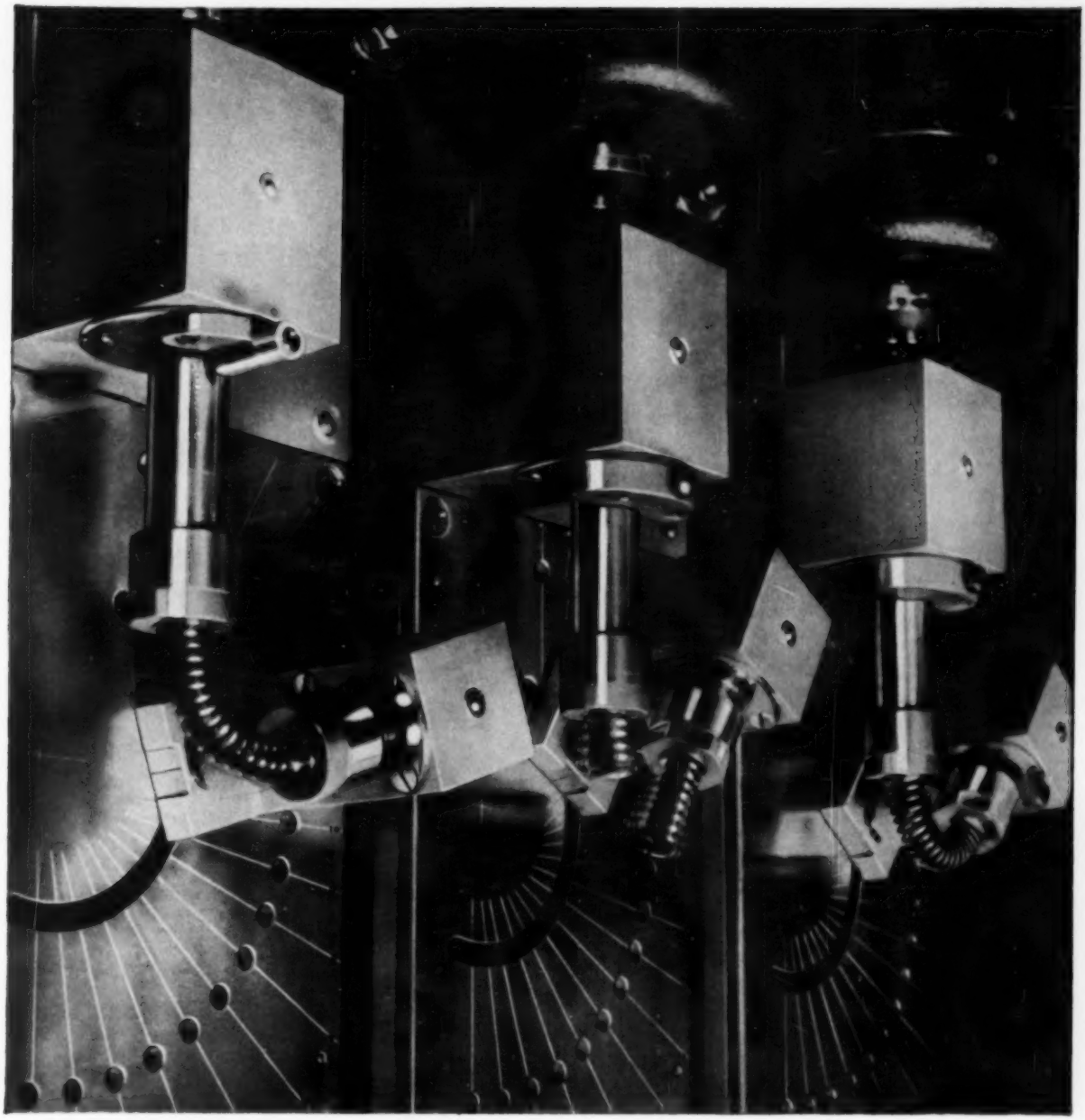

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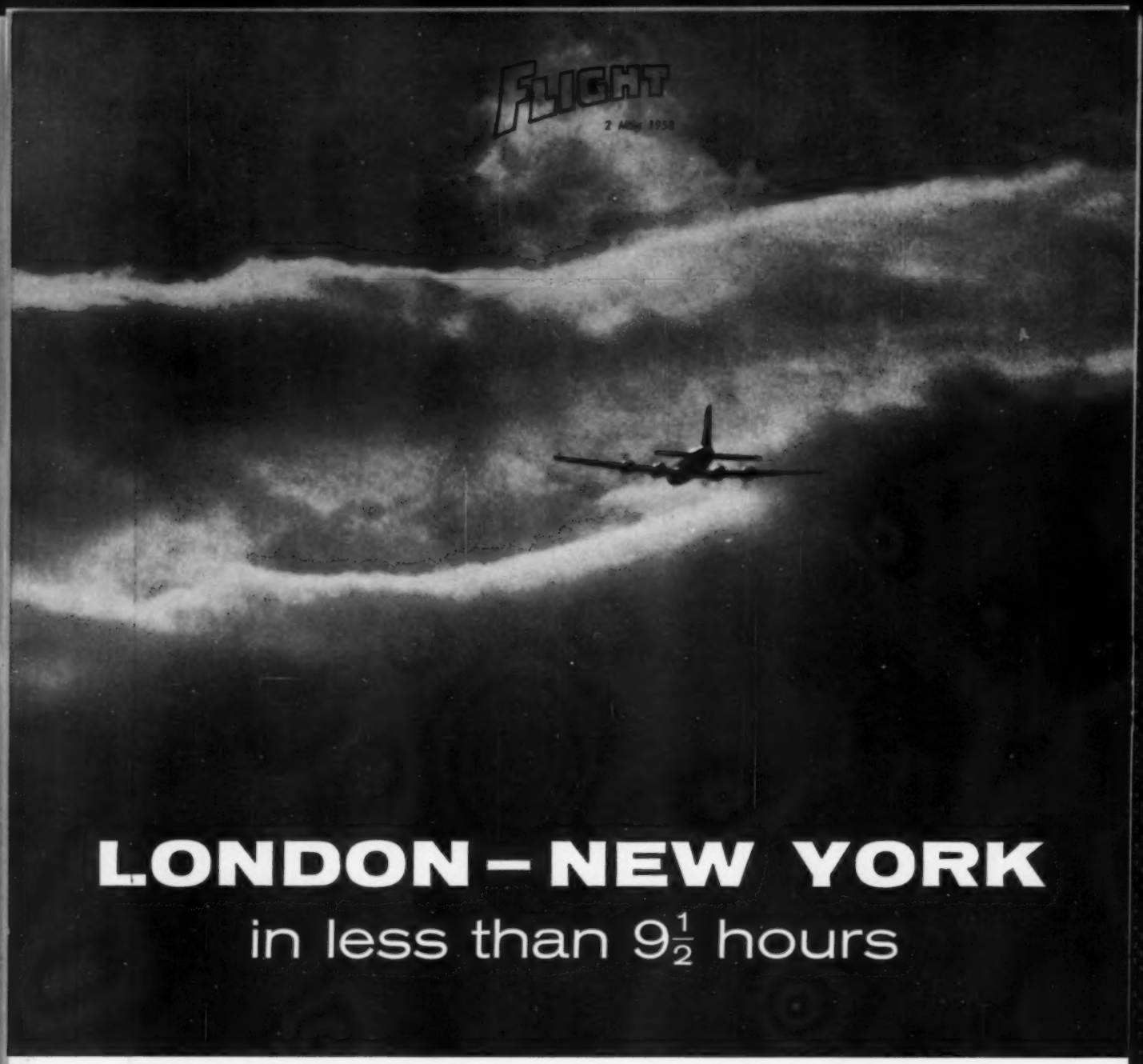

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